



THE  
**Indian Medical Gazette.**

A MONTHLY JOURNAL OF

Medicine, Surgery, Public Health, and General Medical Intelligence  
Indian and European

*EDITED BY*

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**Vol. LXXVII**

*(Founded in 1865)*

CALCUTTA  
HACKER'S PRESS & DIRECTORIES, LTD.

1942





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# "THE INDIAN MEDICAL GAZETTE"

### For the year 1942

[Original Article 'O. A.'; Mirror of Hospital Practice 'H. P.'; Editorial 'E.'; Special Article 'S. A.'; Medical News 'M. N.'; Public Health Section 'P. H. S.'; Current Topics 'C. T.'; Correspondence 'C.'; *Italics* signify Reviews; Reviews are placed under the name of the author; they also appear under the heading 'Reviews', where they are arranged according to subjects.]

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## Original Articles

### SUPERFICIAL KERATITIS DUE TO RIBOFLAVIN DEFICIENCY

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RIBOFLAVIN is a member of the B<sub>2</sub> group of vitamins, the importance of which in human nutrition is being increasingly realized. Riboflavin deficiency in man was first observed in the United States of America, by Sebrell and Butler (1938, 1939). These workers reported the experimental production, in human subjects fed on a deficient diet, of angular stomatitis, accompanied by a reddened, denuded condition of the lips (cheilosis), with greasy dermatitis round the naso-labial folds. In some cases dermatitis in the neighbourhood of the eyes and ears was observed. All these signs disappeared on the administration of riboflavin. Later, Oden, Oden and Sebrell (1939) observed a similar condition in three hospital patients, who were successfully treated with riboflavin. The condition was called 'ariboflavinosis'.

Kruse, Sydenstricker, Sebrell and Cleckley (1940) reported the occurrence of superficial keratitis in cases showing other signs of riboflavin deficiency. Nine cases were observed in this investigation and later the authors (Sydenstricker, Sebrell, Cleckley and Kruse, 1940) reported a further series of 47 cases of superficial keratitis. They observed that the keratitis disappeared in a few days, on the administration of pure synthetic riboflavin. In the same year, Hou (1940), working in Shanghai, described the successful treatment of 36 cases of the same nature.

Typical poor Indian rice diets are deficient in riboflavin, and conditions probably associated with riboflavin deficiency have previously been observed in India. We shall refer to these later. Superficial keratitis responding to vitamin treatment has not hitherto been described by workers in India, but we felt that this condition, if looked for, would readily be found.

#### Investigation

This was carried out in the Government Ophthalmic Hospital, Madras, where facilities were kindly provided by the superintendent and his colleagues. The staff of the hospital was asked to refer to us for observation and treatment cases in which angular stomatitis was present in conjunction with any eye condition. The investigation lasted three months and during this period many cases of superficial keratitis with

angular stomatitis were referred from the out-patient department. From among these, 13 cases in all were treated with riboflavin, with striking and immediate results. The series were limited by the difficulty, at the time when the investigation was in progress, of obtaining further supplies of the pure vitamin.

*Cases observed and treated.*—Of the 13 cases 8 were males and 5 were females, with ages ranging from 8 to 60. While the condition occurs at all ages, there appears to be some tendency for it to be most common in young men and women in their teens; the majority of treated and untreated cases fell into this age group. All 13 patients belonged to the poorer classes, the average reported income of the families of which they were members being Rs. 14 per month. Their diet, according to replies given by them, consisted mainly of rice with no milk and very small quantities of pulses and vegetables—i.e., a diet low in riboflavin.

*Ocular symptoms and signs.*—The patients complained of a burning sensation in the eyes, with mistiness of vision, photophobia and watering. A thick exudate was complained of by some cases. In the majority, examination revealed circum-corneal injection; in a few very early cases this was not evident. In all that showed circum-corneal injection there were opacities in the cornea, in some instances visible on direct inspection and in others only by oblique illumination. The opacities consisted of dots or streaks in the superficial layers of the cornea, some of which stained faintly with fluorescein. In some cases superficial ulcers could be plainly seen. The keratitis does not appear to show any tendency to progress into the deeper layers. It is very resistant to ordinary local treatment as usually applied in hospital. Vascularization of the cornea was present in only three cases.

The conjunctivæ were usually 'dirty' and pigmented. A few cases showed general conjunctival congestion but in the majority congestion was confined to the angles. Phlyctenular conjunctivitis was present in one case and severe blepharitis in another. The latter case did not show acute keratitis, but corneal opacities were present.

Retinoscopy was not carried out because this requires the application of atropine. The latter is part of the routine treatment of keratitis and the object of the investigation was to observe the effect of riboflavin alone without accessory methods of treatment. The fundus, as far as it could be observed through the undilated pupil, was normal. The iris was normal and active in all cases.

*Other signs.*—All showed angular stomatitis of varying degree. The tongue was fissured, but the 'magenta' colour described by the American workers as a feature of 'ariboflavinosis' was not observed. Most patients complained of a burning sensation in the mouth when food was taken. Again, contrary to the American observations,

cheilosis was not a prominent feature. In two cases there was a seborrhœic dermatitis of the face with multiple comedones. In one case a big wet wart was present on the lower lip; this disappeared completely on treatment with riboflavin. All the male cases, on being questioned, complained of itchiness of the scrotum and examination showed that the skin over the scrotum exhibited roughness and scaliness in varying degree. The duration of the symptoms in the different cases varied from 4 days to 18 months.

**Treatment.**—All cases were dealt with as out-door patients. The patients were not advised to change their diets, and local treatment for the eyes, mouth and scrotum was not given. The only treatment was by intramuscular injections of 'lactoflavin, B.D.H.' (N.B.—Lactoflavin and riboflavin are equivalent terms; the latter is now, however, generally employed. The shorter word 'flavin' has also been employed by some workers.) In most cases an initial injection of 2 milligrammes was given followed at daily intervals by further injections of one or two mg. The amount of riboflavin injected varied from 5 to 24 mg., according to the severity of the case.

**Results.**—Within 24 to 48 hours the pain and burning sensation in the eyes markedly decreased and in 3 to 12 days all subjective eye symptoms disappeared. The objective signs of acute superficial keratitis and angular conjunctivitis vanished within this period. While minute superficial streaks and opacities disappeared and with them dimness of vision in most cases, some of the larger opacities persisted after 12 days of treatment. Possibly the larger opacities would yield to more prolonged treatment. In this investigation, however, enough of the pure vitamin was not available for such treatment, and further the treatment was limited because of the very considerable expense of the injections.

After 2 to 3 injections, burning in the mouth was no longer complained of. The tongue fissures usually became very much less evident or altogether disappeared after the administration of about 10 milligrammes of the vitamin. Angular stomatitis took longer to disappear. Scrotal itching vanished, but in most cases the skin of the scrotum did not return to normal during the period of treatment. In one case, however, in which treatment was prolonged and 24 milligrammes given, the scrotal skin became smooth.

A most important observation was that signs of riboflavin deficiency tended to recur within a short period after the administration of the vitamin had ceased.

The table shows the results of treatment, while the figure indicates the position of the opacities in 6 cases. The photograph shows a typical case. The fissuring of the tongue and the photophobia are brought out.

#### Illustrative cases

**Case 1.**—Male, aged 18 years. Complained of photophobia and watering in both eyes for 18 months, with

'weakness of vision' for 2 years. His vision was R.E. 6/36 and L.E. 3/60. His left eye showed two small nebulae in the centre of the left cornea with marginal superficial keratitis staining with fluorescein at the lower margin and vascularization. The right cornea was clear. He had marked angular stomatitis and a fissured tongue. His scrotum was dry, scaly and very itchy. There was a wet wart on the lower lip. He was given injections of 2 mg. of lactoflavin daily for 5 days. The keratitis subsided and the irritative eye symptoms disappeared. Vision became R.E. 6/18 partial and L.E. 6/36. The opacities did not, however, disappear completely. The wart on the lower lip dried up and the lip became smooth. Itching of the scrotum subsided but roughness and scaliness persisted. Treatment was stopped after 6 days. The patient returned in 11 days complaining of some photophobia and itching of the skin of the scrotum again. He was given 1 mg. of lactoflavin daily for another 5 days and these symptoms again disappeared.

**Case 2.**—Male, aged 17 years. Complained of photophobia, burning and watering in the eyes for 3 weeks and 'misty vision' for 3 months. The eyes showed circum-corneal congestion, very marked in the left eye.

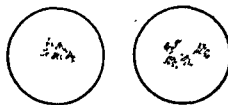
CASE No.3



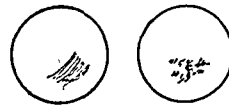
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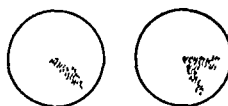
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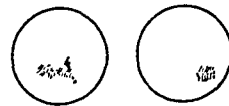
CASE No.10



CASE No.11



CASE No.13



Position of corneal opacities in six cases.

The left cornea had a superficial ulcer and a central opacity. Marked angular stomatitis, fissured tongue, and a rough and scaly scrotum were present. Treatment with 2 mg. of lactoflavin daily was started. After 12 days of treatment the ulcer was healed and no opacity remained in its place. The 'mistiness of vision' disappeared, but the central opacity did not vanish completely. The mouth, tongue and scrotal lesions were completely healed. The patient returned complaining of photophobia and 'mistiness of vision' 15 days after treatment ceased.

**Case 3.**—Male, aged 8 years. Complained of severe photophobia, burning, watering and defective vision at night for 20 days. He also complained of burning in the mouth while eating. Circum-corneal congestion and angular conjunctivitis were present, and there was marked xerosis of the conjunctivæ. The cornea in both eyes showed superficial opacities and keratitis. Angular stomatitis and fissured tongue were present. The skin of the scrotum was smooth. He was given lactoflavin injections, 2 mg. daily. In 5 days all

symptoms had disappeared. The cornea became clear but the xerosis persisted.

*Case 4.*—Male, aged 15 years. Complained of photophobia, burning and watering in both eyes for 4 months. He showed no corneal lesions, while the conjunctivæ were pigmented but free from congestion. There was seborrhæic dermatitis of the face with multiple comedones in the naso-labial angles, and fairly severe angular stomatitis and a fissured tongue were present. He was given an initial injection of 2 mg. of riboflavin, followed by 1 mg. daily for 10 days. The eye symptoms disappeared completely. The seborrhœa and the angular stomatitis were much improved.

*Case 5.*—Male, aged 17 years. Complained of itching and soreness of the angles of the eyes, with sticking together of the lids in the morning. There was slight congestion of the vessels in the angles of the bulbar conjunctivæ and superficial corneal opacities in both eyes. Ulcerative blepharitis was present. This patient had some angular stomatitis, a fissured tongue and seborrhæic scales in the eyebrows. The skin of the scrotum was rough, scaly and itchy. He was treated with lactoflavin, 2 mg. intramuscularly for 12 days. The blepharitis and the exudate disappeared. The angular stomatitis was completely cured and the scrotal skin became smooth. This patient had previously been refused for the army, but after treatment was accepted as a recruit.

### Discussion

Superficial keratitis, as described in this paper, associated with other signs and symptoms of vitamin-B<sub>2</sub> deficiency, is probably a common condition in India. During the investigation in the Ophthalmic Hospital, Madras, many more cases than could be treated were encountered. According to the latest triennial report of the hospital, 300 to 400 cases of superficial keratitis of 'unknown origin' were treated annually in recent years. Probably numerous cases apply to out-patient departments in hospitals in other parts of India.

The relation between superficial keratitis associated with riboflavin deficiency and various types of keratitis referred to in the literature is not clear. Elliot (1920) remarks that superficial punctate keratitis is very common in eastern countries, but offers no suggestions as to ætiology. Herbert (1901) reported an 'epidemic' of superficial keratitis in Bombay in 1900, but the appearances of the lesions in his cases differed in various respects from those observed in the present investigation. Kirkpatrick (1920) described an outbreak of superficial punctate keratitis in Madras—a condition commonly known as 'Madras eye'. 'Madras eye' is said to affect all classes and communities including Europeans and may or may not be the same disease.

A number of investigations on vitamin-B<sub>2</sub> deficiency in human beings has been carried out in India. Aykroyd and Krishnan (1936) described angular stomatitis and glossitis in malnourished children. Eye lesions were not observed in these cases. They reported that the administration of milk or yeast produced a rapid cure, and suggested that the condition might be due to riboflavin deficiency. Milk and yeast are both rich in riboflavin. In later investigations it was found that improvement in some cases of stomatitis, particularly those showing marked

glossitis, could be obtained by the administration of alkaline autoclaved yeast, presumably devoid of riboflavin and also by nicotinic acid (Aykroyd and Krishnan, 1938 and Aykroyd, Krishnan and Passmore, 1939). Nair (1939) and Karunakaran and Nair (1940) have described syndromes in which glossitis and scrotal lesions were prominent, but again without apparent involvement of the eyes. The former gave the name 'oro-genital syndrome' to the condition observed by him. Karunakaran and Nair reported that milk and marmite, but not nicotinic acid, had a curative effect.

There may be certain cases of stomatitis, in which marked glossitis and no eye lesions are present, in which the emphasis is on nicotinic-acid deficiency. This would fit in with the observations of Katzenellenbogen (1939) in Palestine and the experience of Manson-Bahr (1941). The former observed in Palestine a condition which he called 'epidemic glossitis', responding to treatment with nicotinic acid, while the latter concludes that nicotinic acid is effective in the treatment of various kinds of stomatitis. Cases of stomatitis with marked concurrent scrotal lesions (*e.g.*, Govinda Nair's 'oro-genital syndrome' and the cases of Karunakaran and Nair) will probably respond to treatment with riboflavin. It is not clear why some cases of 'orogenital syndrome' show keratitis and not others.

We have remarked on the tendency for the eye lesions to recur within a short time after treatment with riboflavin is stopped. One probable reason for this is the rapidity with which pure riboflavin given in amounts in excess of those present in ordinary diets is excreted, and the high percentage of excretion. In a preliminary investigation in the laboratories (Swaminathan, *in press*) it has been found that in a normal individual as much as 80 to 90 per cent of oral doses of pure riboflavin (2–10 mg.) may be excreted within 24 hours. Excretion in cases of riboflavin deficiency has not yet been studied.

It is at present very difficult to devise a cheap diet of the Indian type, reasonably rich in the vitamin, which could be recommended to patients suffering from 'ariboflavinosis'. A satisfactory fluorimetric method for estimating riboflavin in foods has recently been worked out in the laboratories (Swaminathan, *in press*). It has been found that common Indian cereals, pulses and vegetables are poor sources of the vitamin. The only really potent sources among foods, as far as is at present known, are milk, liver and yeast. A liberal intake of milk is beyond the means of the poor in South India and liver is not a customary food. Dried yeast is at present expensive and supplies are limited. The production of dried yeast from molasses on a large scale might be a solution, provided such a product was sufficiently cheap. Patients on discharge from hospital could be advised to take a small quantity of dried yeast daily. It is possible, but not at all probable, that further study

TABLE  
*The results of treating superficial keratitis with riboflavin*

| Serial number | Age and sex | Amount of lacto-flavin injected, in milligrammes | Days under treatment | Diagnosis  | Result  | REMARKS  |
|---------------|-------------|--|----------------------|--|---|--|
| 1             | 18. M.      | 10   | 5                    | Superficial keratitis                                  | Symptoms and signs disappeared. Some opacities persisted.                 | Came back after 11 days with return of symptoms and was given treatment for a further 5 days. Symptoms again disappeared.    |
| 2             | 17. M.      | 24   | 12                   | Do.  | Do.   | Came back after 15 days with photophobia and mistiness of vision.  |
| 3             | S. M.       | 8  | 5                    | Superficial keratitis and angular conjunctivitis.      | Complete disappearance of signs and symptoms, including opacities.        |  |
| 4             | 15. M.      | 4  | 3                    | No objective signs                                     | Symptoms disappeared  | Patient complained of photophobia, burning and watering.   |
| 5             | 30. F.      | 14   | 7                    | Superficial keratitis                                  | Superficial keratitis disappeared. Small opacities persisted in left eye. | Came back after 12 days with a return of symptoms.   |
| 6             | 60. F.      | 7  | 4                    | Do.  | Symptoms and signs disappeared. Small opacities persisted.                |  |
| 7             | 19. M.      | 6  | 3                    | Superficial keratitis and angular conjunctivitis.      | Symptoms and signs disappeared, including opacities.                      |  |
| 8             | 12. M.      | 12   | 6                    | Superficial keratitis                                  | Do.   |  |
| 9             | 20. M.      | 16   | 8                    | Do.  | Symptoms and signs disappeared. Opacities persisted.                      | Came back after 9 days with photophobia and watering and was given 4 days' further treatment (4 mg.). Improvement as before. |
| 10            | 18. F.      | 6  | 3                    | Do.  | Symptoms and signs disappeared.   |  |
| 11            | 22. F.      | 16   | 10                   | Superficial keratitis and angular conjunctivitis.      | Do.   | Came back after 10 days with same signs.   |
| 12            | 9. F. C.    | 7  | 4                    | Superficial keratitis and phlyctenular conjunctivitis. | Do.   |  |
| 13            | 17. M.      | 24   | 12                   | Blepharitis with corneal opacities.                    | Blepharitis cured. Opacities persisted.                                   |  |

of the riboflavin content of Indian foods may bring to light some other foods which are fairly good sources of the vitamin and at the same time cheap and easily available.

#### Summary

1. Superficial keratitis associated with stomatitis and scaly dermatitis of the scrotum has been observed in South India.

2. Treatment by injection of riboflavin produced a rapid disappearance of signs and symptoms in 13 cases. A tendency to recurrence after the cessation of treatment was observed.

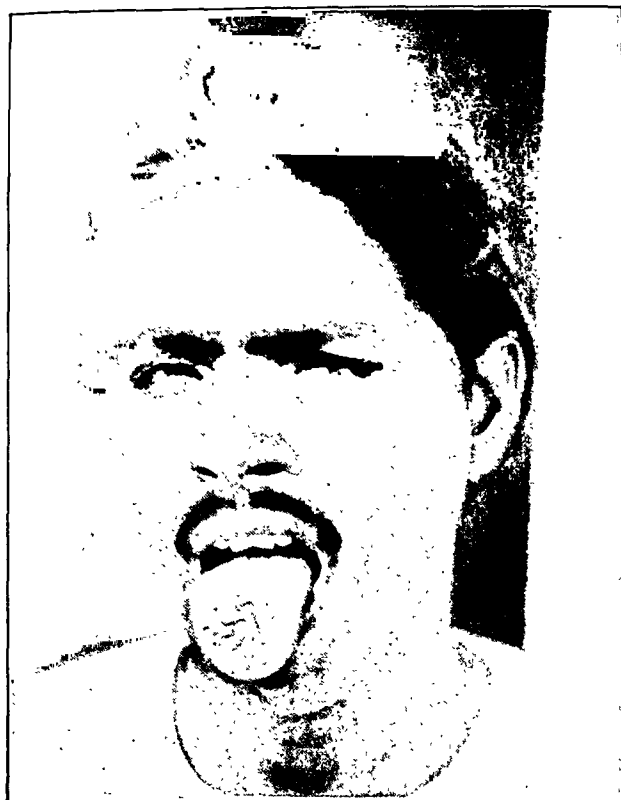
#### Acknowledgments

We are grateful to the superintendent of the Government Ophthalmic Hospital, Madras, Rao Bahadur Dr. K. Koman Nair, Dr. R. E. S. Muthayya, R.M.O., and other members of the staff, for their co-operation in this investigation.

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A typical case, with photophobia and fissuring of the tongue.



Fig. 1.—Confluent smallpox.



Fig. 2.—Discrete smallpox.

TINEA IMBRICATA IN INDIA : DEY & MAPLESTONE

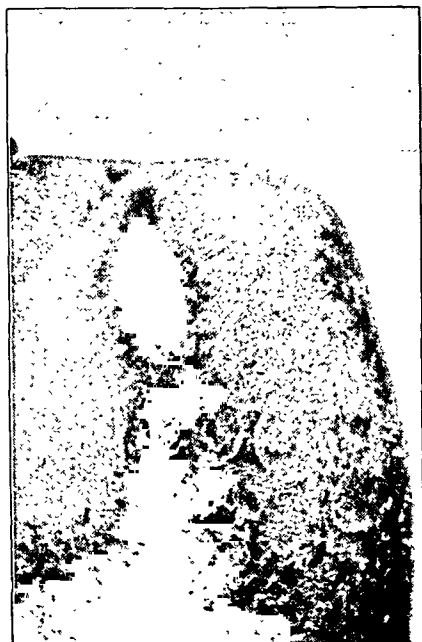


Fig. 1.—Photograph of a typical case showing concentric rings of scales.



Fig 2.—Photomicrograph of a primary culture from a scale on Sabouraud's medium.

PLATE II  
A NOTE ON 'S. V. CHEST BRACE': SHEPPARD



Fig. 1.—Anterior view.



Fig. 2.—Posterior view.

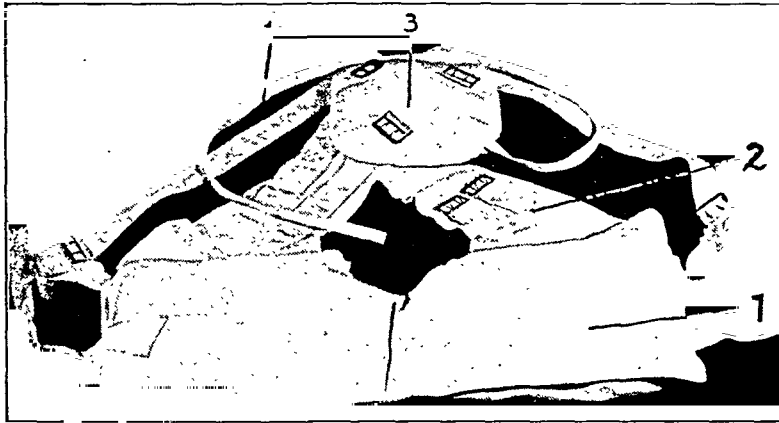


Fig. 3.—(1) The brace with pads inside. (2) Shoulder straps.  
(3) Hip pad. (4) Groin strap.

SCURVY IN THE FAMINE AREAS OF HISSAR DISTRICT: M. MUSA KHAN.



Fig. 1.—Scurvy gums showing the 'beaded appearance' in between the teeth.



Fig. 2.—Hæmorrhagic effusion involving the whole of the left leg of a patient in marked

## TINEA IMBRICATA IN INDIA

By N. C. DEY, M.B., B.Sc. (Cal.)

and

P. A. MAPLESTONE, D.S.O., D.Sc., M.B., B.Sc., D.T.M.

(From the Medical Mycology Inquiry under the Indian Research Fund Association, School of Tropical Medicine, Calcutta)

THIS form of dermatomycosis has been recognized as a distinct type for many years, and is known to be widespread in the eastern hemisphere, throughout the area bounded by Ceylon in the west to China in the east, and Burma and Indo-China in the north to the South Pacific Islands. Apart from two cases mentioned by Castellani as coming from South India (a rather vague region) and one case carefully investigated by Acton and Ghosh (1934), which was proved to have originated in the Mymensingh district of Eastern Bengal, there are no other records in Indian medical literature of its existence in this country.

The disease is not so rare in India as these scanty records indicate, because one of us (N. C. D.), who had considerable experience in various parts of Assam some years ago, saw typical cases in many aboriginal tribes in the hill tracts of this province. At the same time he observed that it was rare in the immigrant inhabitants living on the plains and under slightly better conditions than the aborigines, and that when it was found in a plains-dweller there was invariably evidence that he had had frequent and close contact with the aborigines.

Recently the same author, while on leave in the Kamrup district of Assam, took the opportunity of collecting scales from five different

persons from different villages, and this material has been subjected to laboratory investigation. In the primary cultures on Sabouraud's medium it was found that the cultures from two cases resembled *Endodermophyton tropicale* Castellani, and three of them, *E. indicum* Castellani. These differences are slight and on sub-culture on glucose agar under constant oxygen tension the two types became indistinguishable; as our cultural results are almost identical with those of Acton and Ghosh we are not giving them in detail in this paper. We failed to grow the fungus on 'natural' media such as wheat, barley and rice, and Acton and Ghosh failed to grow it on damp wood, leather, coir matting, mud, etc., on all of which the common dermatophytes grow readily. We also had some success in animal inoculation as we obtained a transient infection on the scarified skin of guinea-pigs where the above workers were unsuccessful.

Acton and Ghosh expressed the view that *E. tropicale* and *E. indicum* were probably identical but as they had only a single strain of fungus to study, they could not prove it definitely. Our results, based on the study of material from five different cases, have shown that Acton and Ghosh were correct in their suggestion.

*Nomenclature of the causative organism.*

Castellani and Chalmers (1913) listed three species of the genus *Endodermophyton*, namely, *E. concentricum* Blanchard, 1896, *E. indicum* Castellani, 1911 and *E. castellanii* Perry, 1907. In the third edition of their book the same workers (1919) added the two species *E. mansonii* Castellani, 1914 and *E. tropicale* Castellani, 1914. Thus at this time it was claimed that there were five species of fungus responsible for supposedly slightly varying types of tinea imbricata in the eastern hemisphere. Dodge (1935) placed *E. castellanii* and *E. mansonii* as synonyms of *E. concentricum* and Ota and Kawatsur  (1931), said they were unable to differentiate *E. concentricum* and *E. indicum* as the result of the study of a culture supplied by Castellani; finally we have proved that *E. indicum* and *E. tropicale* are identical, therefore, four of the above species fall as synonyms of *E. concentricum* which is accordingly the sole cause of tinea imbricata in Asia and the Eastern Archipelago.

The generic name *Endodermophyton* first appeared in Castellani and Chalmers (1910) as '*Endodermophyton* Castellani, 1909' but in the same publication there is '*Endodermophyton castellanii* Perry, 1907'. On this account there is some doubt as to whom the generic name *Endodermophyton* should be ascribed and Dodge (1935) gets over the difficulty by writing *Endodermophyton* Perry, 1907; Castellani and Chalmers, 1910. Castellani defines the genus as characterized by the fact that the fungus grows between the superficial and deep layers of the epidermis, and in discussing the cultural characters he says that Sabouraud

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and Pinoy, to whom he referred his material, drew attention to the similarity of the growth of this fungus to that of the genus *Achorion*. Guiart and Grigorakis (1928) in their system of classification give *Endodermophyton* as a synonym of *Achorion*, but Dodge (1935) does not accept this system because he says that several of the rules of nomenclature have been ignored in drawing it up, so he retains *Endodermophyton* as a valid genus. Before publication of his book, Dodge probably did not see the paper by Acton and Ghosh (1934) who considered the differentiation between *Achorion* and *Endodermophyton* unjustified, and our results agree with theirs so it is probable that eventually the name of this species will be finally agreed upon as *Achorion concentricum* Blanchard, 1896 (Guiart and Grigorakis, 1928).

It should be added that there are two other species in this genus, namely, *Endodermophyton roquettei* Fonesca, 1925, and *E. africanum* Dodge, 1935, which are responsible for similar clinical conditions in South America and Africa, respectively.

#### *Clinical characters of tinea imbricata*

As it appears probable that this disease may be commoner in India than is realized and it is possible that, like yaws, it will be found in aborigines in other districts than Assam, if it is looked for by anyone competent to diagnose it, we give the following short description to help the uninitiated to recognize it if they happen to encounter it :—

The disease may begin anywhere on the skin surface as round or oval macules a few millimetres in diameter. The horny layer soon breaks in the centre forming a ring of scales attached by their outer borders; the infection goes on spreading and successive new rings of scales begin in the centre and spread in turn, so that eventually there is a circular lesion composed of concentric rings of scales. Large areas of the body surface are generally involved and the circular lesions run into each other so that a fully-developed case presents a system of parallel wavy lines which at first glance creates the impression that a complicated series of figures has been tattooed on the skin; the appearance of tattooing is enhanced on a dark skin because the lines of scales stand out whitish against the dark background. Irritation is usually severe but inflammation is not a prominent feature; the hairs are not affected.

Diagnosis is usually easy, but in old cases with large scales in which the typical ringed appearance has become indistinct the condition may be mistaken for ichthyosis; a search will usually reveal a newer lesion, however, in which the characteristically concentric rings of scales are still apparent.

Treatment is tedious as the infection yields slowly and it is usually so extensive that only

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## SCURVY IN THE FAMINE AREAS OF HISSAR DISTRICT, PUNJAB

By MOHD. MUSA KHAN, M.B., B.S., D.T.M.; D.P.H.  
Nutrition Officer, Public Health Department, Punjab

THERE are many records in the past of the occurrence of scurvy when individuals or groups of individuals are so situated that they are unable to obtain fresh food.

The district of Hissar in the south-east of the Punjab has been visited by famine on many occasions during the past 250 years. There are records of famine occurring in this area in 1783, 1860-61, 1869-70, 1896-97 and 1899-1900.

It is surprising that in the records of these visitations there is no definite mention of scurvy as a cause of death, although death-rates were very high indeed and the population was reduced to dire straits. Some idea of the state of affairs may be gathered from extracts from district gazetteers. The following is taken from the gazetteer of 1915 (Fagan and Townsend, 1916):—

'The first famine of which we have any authentic account is that of A.D. 1783, the "Chalisa Kal" or

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a part can be treated at a time. Castellani recommends his fuchsine paint and a useful alternative application is one composed of one drachm each of resorcin and glacial acetic acid in one ounce of compound tincture of benzoin.

The epidemiology of tinea imbricata is interesting because it has remained relatively localized to certain races and areas, unlike the other dermatophytes which seem to have spread almost over the whole world in the last twenty years, and have involved all races and classes of people. The comparatively limited distribution of this disease is explained by the fact that the fungus does not appear to be capable of maintaining an independent saprophytic existence on leather, wood, mud, etc., as the other species are able to do so that infection can only be acquired by direct contact.

#### Summary

The identity of all the species of *Endodermophyton* causing tinea imbricata in the eastern hemisphere is confirmed and attention is drawn to the possibility that this disease is commoner in India than is now recognized.

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famine of "San Chalisa" (Samat 1840) by which the whole country was depopulated. . . . The peasants abandoned their villages and died by thousands of disease and want . . . and none remained behind who had strength to fly. No reliable statistics of the mortality are extant, but there can be no doubt that the people suffered terribly. Some died helplessly in their villages, others fell exhausted on the way towards the south and east, where they thronged in search of food and employment. The price of the commonest food grains rose to 5 and 6 seers per rupee. Fodder for cattle failed utterly and the greater part of the agricultural stock of the district perished. But for the berries found in the wild brushwood the distress would have been even greater.'

Although scurvy is not mentioned, the following extract from the same source is significant and indirectly suggests that scurvy may have been present :—

'Many immigrants from Bikaner again came into the district and the poor who were unable to buy grain supported themselves on the fruit of the *karil*, which is unwholesome when eaten in any quantities, and on the leaves of the *jal* or *pilu*. But whether the jungle fruits were wholesome or not, they were the means of saving many lives: for in this year of famine the crop of wild fruit was larger than had been ever before remembered and during the month of June gave food to many thousand people.'

Quite apart from actual famine there have been in Hissar district in recent times many years of scarcity not amounting to famine, when crops failed partially and local food supplies were much reduced.

The present famine which has not yet ended began in 1938, famine being officially declared by Government in December of that year. Throughout the whole of the 1939 acute famine prevailed, and it was not until the occurrence of rain in the year 1940 that the famine was mitigated to a limited extent: relative famine continued, however, throughout 1940 and into the first half of 1941.

A survey carried out by me during the months of February and March 1939, in two typical famine-stricken regions of the district, provided data on which an estimate could be formed of the character of the diets being consumed by the population, and the physical state of the people. The survey produced very interesting information. The outstanding characteristic of the diets consumed by the people was a complete absence of green vegetables. Milk and milk-products also were almost entirely absent from diets. Briefly stated the diets consisted mainly of cereals, with pulses in small amount and condiments. The only relieving feature about the diets was that they were quantitatively sufficient, i.e., yielded just enough calories for the kind of work the people were required to do. Otherwise, the diets were extremely ill-balanced. They contained practically no proteins or fats of animal origin. They were positively deficient in calcium. Above all, their vitamin content was extremely low. Vitamin A was utterly inadequate and vitamins C and D were altogether absent.

As regards physical condition 82 per cent of workers on famine relief works and 50 per cent

of non-workers were found to be nutritionally sub-normal. The state of nutrition of young children is a sensitive index of the nutritional state of the individuals of the community from which they are drawn. Eighty-four per cent of school children were found to be sub-normal physically. A majority of these children showed positive and well-defined signs of malnutrition, i.e., dryness of the skin, phrynoderma, xerophthalmia, and even stunted growth.

It is interesting to note that in the population surveyed by me no case of clinical scurvy was found at this early stage of the famine.

In December 1939, a rather sudden deterioration in health conditions occurred in the district, accompanied by a material increase in death-rates. This led to careful investigations in a number of selected villages which resulted in the discovery of cases of scurvy. From December 1939 on to the end of March 1940, cases continued to occur, but with the application of appropriate preventive measures the disease disappeared during the months of April, May and June 1940, only to reappear when these measures were, in the first instance, curtailed and later discontinued altogether. It is interesting to know that scurvy appeared to have been stamped out by the issue of germinated grain (Nicol, 1940) to the famine-stricken population. It is still more interesting to know that on the discontinuation of germinated grain, the disease reappeared, and disappeared a second time when germinated grain was reintroduced as a prophylactic. The following table provided by Lieut.-Colonel C. M. Nicol, M.A., M.D., I.M.S., Director of Public Health, Punjab, shows the sequence of events.

Of the total of 351 cases of scurvy which came to light between December 1939 and December 1940, I personally saw and treated 42 cases. There are, however, accurate records of 150 additional cases which were admitted into dispensaries throughout the district for treatment. The records of these cases were kept by doctors in charge of dispensaries, but I saw a majority of these cases and was able to confirm the diagnosis.

Of these 192 cases, 156 came from the Hansi and Bhiwani tehsils of the district. This is interesting, because scarcity of food in recent years has been much more marked in these two areas than elsewhere in the district.

*Seasonal occurrence.*—The seasonal occurrence of the disease cannot be satisfactorily estimated because of the obvious effect of preventive measures. Perhaps a more important point is that the disease was not discovered until more than a year after the famine had commenced. It is most unlikely that the disease really developed as suddenly as it would appear to have done, judging from the available figures. Sub-clinical scurvy unquestionably existed for many months before the fully-developed disease was diagnosed. Of this there can be little doubt, because of the known absence of vitamin C

from the diets on which the population were living. Enquiry, too, showed that the clinical picture of scurvy was quite well known in many villages in which death-rates had been greatly

succeeded in doing so, cases of scurvy were found.

During the whole of 1939, it should be remembered, doctors were not touring in villages and

TABLE

*The effect of public health measures on mortality and the incidence of scurvy in Hissar famine areas*

| Main factors operative in relation to health  |                  | Total deaths | Increase (+) or decrease (—) compared with the corresponding month of the previous year | Number of cases of scurvy discovered and treated |   |
|---|------------------|--------------|---|--|---|
| December 1939: Preventive and curative work reorganized and expanded, and brought under one control.  | 1939<br>December | 2,455        | — 278   | 67   | Period during which special measures were continuously applied. |
| Amla juice introduced for treatment of scurvy.  | 1940<br>January  | 2,299        | — 1,586   | 80   |   |
| First week of February: Germinated grain introduced as a prophylactic against deficiency disease. Bi-weekly issues (1 oz. dry grain) to approximately 200,000 individuals continued until the end of May. | February         | 1,918        | — 1,275   | 60   |   |
|   | March            | 2,177        | — 859   | 9  |   |
|   | April            | 2,643        | — 453   | nil  |   |
|   | May              | 3,290        | — 311   | nil  |   |
| Reduction in issue of germinated grain.   | June             | 3,177        | — 849   | nil  | Progressive discontinuation of special measures.                |
| Closure of relief works and works dispensaries, and gradual stoppage of issue of germinated grain.  | July             | 2,591        | — 931   | 2  |   |
|   | August           | 2,868        | — 188   | 2  |   |
|   | September        | 3,564        | + 1,002   | 53   |   |
| No relief. No germinated grain ..   | October          | 3,482        | + 1,000   | 48   | Reintroduction of special measures.                             |
|   | November         | 3,288        | + 935   | 21   |   |
| Gratuitous relief and germinated grain reintroduced for 140,000 individuals.  | December         | 2,668        | + 213   | 9  |   |
|   | 1941<br>January  | 2,042        | — 217   | nil  |   |
| TOTAL ..  |                  |              |   | 351  |   |

TABLE

*Distribution of cases*

| Affected areas     | TEHSILS OF HISSAR DISTRICT |         |        |           |       | Adjoining villages of Bikaner State | Total |
|--------------------|----------------------------|---------|--------|-----------|-------|-------------------------------------|-------|
|                    | Hansi                      | Bhiwani | Hissar | Fatehabad | Sirsa |                                     |       |
| Number of cases .. | 117                        | 39      | 23     | 10        | 1     | 2                                   | 192   |

increased during the famine, causes of death being notified as 'dysentery', 'fever' and under other general headings. A factor of importance in explaining the fact that scurvy did not come to light sooner is the natural reticence of the people living in these areas. It was with the greatest difficulty that I was able to induce villagers to bring out their sick from their houses and, on more than one occasion, when one had

were not coming into contact with the sick in their own homes. The general re-organization of health work which allowed of dispensary doctors touring, greatly facilitated the discovery of cases and the bringing of them under treatment. Systematic search was, in fact, made in all villages for cases of scurvy.

Racial distribution is shown by the following table :—

TABLE

| Race             | HINDUS |          |          |         |         |       | MUSLIMS |        |       | GRAND TOTAL. |
|------------------|--------|----------|----------|---------|---------|-------|---------|--------|-------|--------------|
|                  | Jats   | Brahmans | Mahajans | Bishnoi | Menials | Total | Rajputs | Others | Total |              |
| Number of cases. | 133    | 10       | 2        | 2       | 32      | 179   | 10      | 3      | 13    | 192          |

We are dealing with a relatively small group of cases so that one cannot be dogmatic. The general proportion of Hindus and Muslims in the district is 3 to 1 according to the 1931 census. The racial distribution, therefore, as indicated in the table, is not in accordance with the relative proportions of the inhabitants.

*Sex distribution.*—Out of 192 patients, 138 were males and 54 females. No great stress can be laid on this sex distribution. As mentioned above it is difficult to get villagers to produce their sick, particularly their women folk, as purdah is observed by a large proportion of the inhabitants, particularly Rajputs, both Hindu and Muslim.

*Age incidence* is shown in the following table:—

potatoes, onions, radish or other vegetables occasionally, but not oftener than once or twice in a fortnight or a month. Even in such cases the quantity of vegetable consumed per head was very small, a pice ( $\frac{1}{4}$  anna) worth of vegetable weighing about 5 oz. being shared by a whole family of half a dozen or more members. Seven of these 32 patients said that a certain amount of milk was available in their homes, the amounts per household varying from 2 to 16 lb. per day, and these amounts were shared by 6 to 8 individuals.

*General appearance.*—A majority of the patients looked thin and anæmic, but two out of the 32 looked well covered and well fed.

*Onset.*—The onset of the illness was gradual in the majority of cases. Nineteen patients

TABLE

| Age group        | AGE IN YEARS    |         |          |          |          |          |          | 60 and upwards | Total |
|------------------|-----------------|---------|----------|----------|----------|----------|----------|----------------|-------|
|                  | Infants under 5 | 5 to 10 | 11 to 20 | 21 to 30 | 31 to 40 | 41 to 50 | 51 to 60 |                |       |
| Number of cases. | 3               | 3       | 4        | 25       | 39       | 48       | 43       | 27             | 192   |

A glance at the table shows that all age groups were affected.

*Social and economic status of the sufferers.*—The patients came from all the social and economic strata of villages, from the comparatively well-off landowners and shopkeepers down to menials. The fact is that the famine had obliterated many social and economic distinctions and practically the whole population was reduced to a common nutritional level, at least qualitatively.

*The clinical picture of scurvy.*—I propose to describe scurvy as it appeared in the famine areas of Hissar and as it manifested itself in 32 cases with which I was more immediately concerned. It will be possible, however, to show that the clinical picture was fairly uniform throughout, and that the clinical findings of dispensary doctors corresponded very closely with mine.

#### *Dietetic history*

This confirmed the deductions made from the dietetic survey. Of the 32 patients at one centre, 8 stated that they had not taken green vegetables, cooked or fresh, for a period of 6 months. The remaining 24 had eaten cooked

(60 per cent) experienced early symptoms such as headache, backache, lassitude, disinclination to exertion, depression and even loss of appetite, 5 to 7 days before characteristic symptoms appeared. In a few cases this period of lethargy and loss of energy was of a longer duration and varied from a fortnight to a month. One of the patients stated that about a week before the actual illness, he felt a whirling sensation and giddiness in his head and a feeling as if he were going mad. He lost all interest in life and did not like to talk to other people or even smoke a *hukka* (hubble-bubble) with them. The onset of the disease in the case of the remaining 13 patients (*i.e.*, 40 per cent) was much more sudden: they did not experience the early general feelings of malaise.

*Signs and symptoms.*—The 32 cases varied in the duration of the disease and in its acuteness. The only two features of the illness constantly present in the 32 cases were—

- (i) spongy bleeding gums with shaky teeth and foul breath, and
- (ii) absence of pyrexia.

A majority of the cases had pain, swelling and tenderness of joints, and tender swellings in the

muscles of the limbs. The lower extremities were involved much more frequently than the upper extremities or other parts of the body. Pain in muscles and joints was severe and of a stabbing character. In the more acute cases the patient was immobilized by the pain.

*Gums and teeth.*—In certain cases involvement of the tissue of the gums was so great that polypoid growths actually hung from the gums between the teeth. The slightest pressure caused bleeding from the gums. It is of interest to note that pyorrhœa is a very common condition amongst all classes of the population in Hissar district, but to what extent the specific effects of vitamin-C deficiency were superimposed upon a pre-existing pyorrhœa, it is not possible to say. Even if we assume that the mouth condition was so superimposed, the picture was very distinctive and conformed to the orthodox description of scurvy gums given in books, only it was much exaggerated. In fact, the disease could without difficulty be diagnosed by an examination of gums and teeth. These hypertrophic tissues were seen both externally and internally to the line of the teeth (plate II).

The gums and teeth were extremely painful and very tender to touch and difficulty was found in taking even fluid diet.

*Hæmorrhages.*—In scurvy, swellings in joints and in muscles are ordinarily ascribed to hæmorrhages into these structures. In a majority of the 32 cases very definite swelling of joints was present and, in addition, large swellings in the muscles, particularly of the lower limbs. It is presumed that these swellings were due to hæmorrhages because even in brown-complexioned individuals the skin over these swellings had the appearance of an ordinary extravasation of blood. The appearance was the bluish dark-red appearance of a severe bruise.

In some cases these effusions involved practically the whole of a limb, which appeared to be double the normal girth. The petechiæ ordinarily described in connection with scurvy were not found, perhaps owing to the fact that they could not be detected on dark skins. In two cases, there was a history of repeated epistaxis and two other patients gave a history of passing blood in the stools and of hæmoptysis.

*Pains and swellings.*—Swellings in limbs were extremely tender to touch. The skin over the swelling looked stretched and had a glossy appearance. The swelling was hot, tense and firm to touch and did not pit on pressure, and patients lay with joints flexed and in the severe cases were quite unable to move. On the slightest attempt to move them, they shrieked in agony. Although in most cases it was the larger joints that were swollen and painful, yet in a few cases the smaller carpal and metacarpal, and tarsal, meta-tarsal and phalangeal joints were involved also. The ankle joints were so frequently involved that

villagers themselves called the disease by a word meaning 'swollen feet' (plate II). When the swellings subsided under treatment there was desquamation of the skin of the part.

Plimmer and Plimmer (1936) state that the bones in scurvy become brittle. There was one case of an elderly man who had suffered from scurvy over a period of months. He fractured his femur by falling from his bed—a height of about two feet—while attempting to move.

*Sequence of the appearance of symptoms.*—The order of appearance of signs and symptoms is interesting. In 66 per cent of the cases described, swelling in limbs and joints preceded any complaint regarding gums and teeth.

*Notes on typical cases.*—A detailed description of a few typical cases is given below:—

*Case 1.*—A Hindu Jat female, aged 60 years, wife of a village headman owning 150 acres of land. She was admitted on 9th February, 1940, in a bed-ridden and helpless state. Duration:—20 days.

*History.*—She had had no milk or vegetables for 6 months before her illness. About 10 days before the characteristic signs and symptoms of the disease appeared she felt lassitude, loss of energy and disinclination to work. Twenty days before being seen she felt 4 knotty swellings in her right thigh and 4 days later she got a big hard lump in her left thigh. Soon after that her left foot and ankle became much swollen and tender. She did not have any bleeding from the gums.

*On examination.*—The left foot, ankle, leg and thigh were swollen, tense and tender. The calf muscles of the left leg were stony hard, tender and hot to touch. The skin of the leg had a shiny appearance. There was a big hard lump 5 inches by 4 inches on the inner side of the left thigh and there were 4 smaller knotty swellings each about the size of a walnut close together on the outer side of the right thigh. The skin over these swellings was of a bluish hue. They were extremely painful on pressure. Both knee joints were tender on pressure, but they were only slightly swollen. The gums were spongy and tender to touch but not markedly so although she had pyorrhœa and shaky incisor teeth. She had no pyrexia.

*Case 2.*—A Hindu Jat, aged 70 years, a well-to-do landowner who did not accept the Government's gratuitous relief. Admitted on 26th February, 1940. Duration:—10 days.

*History.*—He had 16 lb. of cow's milk per day in his home in a family of 8 at the time of the occurrence of the disease. He also partook of cooked vegetables occasionally—once in a month or so. He did not experience any early symptoms at all. First of all he felt pain in both his knee joints, which became swollen, the right one first. Subsequently the swelling extended to both his calves, ankles and feet and he became bed-ridden. A week after the pain and swelling in the knees he developed swelling in the gums which became so painful that he could not take his food.

*On examination.*—Owing to severe pains the patient was actually weeping at the time of his admission. He had bad pyorrhœa and foul breath. The gums were markedly swollen and spongy and showed 'beaded appearance'. They bled on touch. Both the knee and ankle joints were swollen, hot and tender. He kept his knees flexed and immovable. The muscles of both his calves and thighs were tense and painful and marks like bruises were seen on the skin. There was no fever.

*Case 3.*—A Muslim Rajput, aged 56 years, a chronic case. Admitted on 17th January, 1940. Duration:—4 months.

*History.*—He had had no milk or vegetables for a year. A month before falling ill he lost energy and

felt fatigued. He also lost his appetite. One day on getting up from his bed he noticed swelling of his left thigh. Soon both his thighs and legs became swollen and painful and he became bed-ridden. Then all the joints of his lower extremities became inflamed and tender. About 20 days later his gums became swollen and bled profusely. The swellings between the teeth became pedunculated and he used to snip them off with his fingers. Simultaneously with the swelling of the gums he got bleeding from his nose—which continued for 10 days. Three months after the onset of the disease both his shoulder joints were also involved followed by the elbow and wrist joints of the left arm. They became swollen and intensely painful. The elbow and wrist joints of the right arm were not affected at all.

*On examination.*—The muscles of the thighs and legs were tense, swollen and painful on pressure. The hip, knee, ankle and shoulder joints were likewise swollen and extremely tender. The knee joints were fixed in the flexed position. The elbow and wrist joints of the left arm were both swollen and tender and the patient was unable to flex the fingers of his left hand. The patient was lying in a helpless state and was not able even to sit up in his bed. The gums at that stage were slightly swollen and tender.

*Diagnosis.*—The clinical picture of the fully-developed disease made diagnosis a comparatively simple matter when the possibility of scurvy was kept in mind. As will be mentioned later, the astonishing rapidity with which cases reacted to anti-scorbutics left no doubt as to the nature of the condition. Nevertheless, many cases must have escaped notice during 1939, and, even when dispensary doctors were informed of the likelihood of scurvy being found, cases were mistaken for other conditions. More than once scurvy was diagnosed as beri-beri, although on general grounds it was most unlikely that this disease should occur in an area in which the people were eating nothing but whole grain of various kinds. The confusion arose from the helplessness of an individual and his inability to move, which was wrongly believed to be due to neuritis, and also owing to the swelling of ankle joints. In many cases the name of a symptom was given to the disease. There was a tendency to dismiss cases by calling them simply pyorrhœa or rheumatism. A term 'famine œdema' was coined\* to cover others.

*Treatment.*—Treatment consisted of—

- (i) the giving of anti-scorbutics in concentrated forms, and
- (ii) the provision of a properly-balanced diet.

*Anti-scorbutics.*—When cases first began to appear, orange juice or tomato juice, or both combined, were given. At the end of December 1939, however, I was informed of the work done by Giri (1939) on the vitamin-C content of the Indian gooseberry or *amla*, and as this berry flourishes in the Punjab, it was an easy matter to get large quantities.

Fresh juice of the *amla* was used and later on, when the fruiting season of the *amla* was over, a powder prepared from the dry fruit was used instead of the fresh juice. The 32 patients

dealt with here were all treated by fresh *amla* juice excepting one who was given *amla* powder. The juice of 12 *amlas* was given per head per day. Fresh *amlas* were washed with water and scraped into small shreds on an ordinary household grater. Patients, whose oral condition permitted, were given the scraped *amla*. Others were given the juice squeezed from the scrapings. The juice was extracted from the scrapings by adding a little water, grinding them with pestle and mortar and straining through a piece of muslin. The residue left after straining was added to the liquid cooked diet of the patients who were on juice. A little sugar in the form of gur was added to the scrapings and juice to disguise the bitter taste. 12 *amlas* weigh, on an average, about 100 gm. and contain approximately 500 mgm. of ascorbic acid.

The results of treatment by *amla* were very dramatic. Within 24 to 48 hours of the commencement of treatment, pains disappeared and the swelling of the gums began to subside from the second day onwards. A patient immobilized through pains and swellings in his joints could sit up in bed on the fourth or fifth day from the commencement of treatment, and able to stand up and walk round his bed after a week. The average patient had recovered after a fortnight's treatment. One young man, who wept on account of the pains in his limbs, a fortnight later literally jumped in the air to demonstrate his recovery.

In another group of 10 cases—all typical scurvy—found later on in the famine areas, pure ascorbic acid was used in the treatment. It was found that results comparable to those obtained with *amla* juice in the quantities above stated could not be obtained on a dosage of less than 150 mgm., 3 times per day, making a total of 450 mgm. daily. Pure ascorbic acid was given by hypodermic injection in one case only. This method of administration appeared to have no advantage over oral administration.

Only one out of the 32 cases dealt with in this series was treated by *amla* powder. The powder was given in 6 other cases in which records were maintained. I myself gave the powder in 2 cases. The powder was prepared in the following manner in the month of March 1940. Fresh *amlas* were scraped on a household grater and the scrapings dried in shade were reduced to powder state by grinding in a handmill. It was stored in the cold-room of the Punjab Vaccine Institute, Lahore, and was used in the month of November 1940. The ascorbic-acid content of the powder was estimated by Harris and Ray's method by Mr. B. L. Khuller, M.Sc., A.I.C., Public Health Chemist, who found that it contained 17 mgm. ascorbic acid per gramme. Eight gm. of this powder was given 3 times a day. The results were comparable to those obtained with the fresh juice and with pure ascorbic acid.

\*The term is surely a well-established one.—EDITOR, I. M. G.

## A NOTE ON 'S. V. CHEST BRACE'.

By F. A. B. SHEPPARD, O.B.E., F.R.C.S.  
MAJOR, I.M.S.

and

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IMMOBILIZATION of the chest wall by different mechanical aids has been attempted with varying successes during the past 40 years. The methods vary not only with the object for which restriction of movements of the chest is indicated, but also with the ingenuity of the attempts to achieve the immobilization.

Sewall and Swezey (1921) used adhesive strapping around the chest at the axillæ. The same method was later used by Golden (1923) and Lilienthal (1925). Sauerbruch and Schumacher (1911) used a harness after thoracoplasty. Gravesen (1925) described in his English text his 'bandage' harness. An encircling plaster cast was used after thoracoplasty by Levitt (1922). Roberts and Nelson (Alexander, 1937) have described the use of a post-thoracoplasty brace. Weighted bags have been used by many surgeons to compress the lung over the decostallized area.

(Continued from previous page)

#### Summary

1. The nutritional background against which cases of scurvy occur in a famine area is described.

2. A general description is given of the clinical picture of scurvy as it occurred in the famine areas of Hissar district and illustrative cases are described in detail.

3. An account is given of the results of treatment of clinical scurvy by the juice of the Indian gooseberry or *amla*, by a dried powder prepared from the *amla*, and by pure ascorbic acid.

4. The efficacy of germinated grain as a prophylactic of scurvy is referred to.

#### Acknowledgments

I am grateful to Lieut.-Colonel C. M. Nicol, I.M.S., Director of Public Health, Punjab, for help in the preparation of this paper and to Dr. R. C. Puri for his assistance in the management and treatment of a selected number of cases of scurvy at the Siwani Rural Dispensary, Hissar District.

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Woodruff's (1932) brace which has been regularly used in Alexander's clinic is simple, efficient and useful. It does not, however, avoid restriction of movement of the normal side of the chest, as the pressure pad on the operated side is strapped to, and counter pressure obtained from, a ring round the opposite shoulder.

The following conditions should be satisfied if a chest brace is to be considered efficient:—

1. It must produce sufficient compression.
2. It must be light.
3. It must be cheap.
4. It must be simple in construction.
5. There should be no restriction of movement of the opposite side of the chest.

Bearing the above points in view, on the suggestion of the senior author, one of us (R. V.) made a simple chest brace which we have found quite satisfactory in practice.

A sample brace was made out of a cut *banyan* (underwear) and a torn pillow, parts of which were stitched up into compression pads. Finding that it worked satisfactorily we made a properly tailor-stitched brace, a description of which is given below.

The compression is obtained by a piece of canvas or thick drill sufficient to go round and to suit the contour of the anterior and posterior walls of the hemithorax. The side of the canvas which is in contact with the chest wall has two pockets, one in front and the other behind, into which can be introduced a series of pads whose number is determined by the amount of compression required. The canvas is slung over the shoulder of the same side by adjustable straps. Y-shaped straps are fixed to the medial side of the brace anteriorly and posteriorly. Counter-pressure is obtained by a contralateral hip-pad to which the distal ends of the Y-shaped straps are fastened. The hip-pad in its turn is fixed in position by a groin strap which goes round the thigh of the same side.

The advantages of this chest brace are the simplicity and cheapness of its construction, its adjustability and the absence of pressure on the contralateral hemithorax.

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## ACHLORHYDRIA AND ANÆMIA

## AN ANALYSIS OF 79 CASES

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NORMAL gastric juice contains hydrochloric acid, pepsin, rennin and the intrinsic factor of Castle. The secreting function of the stomach may be investigated by means of a fractional test meal. As ordinarily performed, the examination gives information only as to the hydrochloric-acid formation; the presence of pepsin and rennin can be recognized by *in vitro* test, but for the detection of the intrinsic factor *in vivo* tests are necessary.

Davis (1931) by using the histamine test meal was able to demonstrate that the failure of the stomach function was probably progressive; his investigations (confirmed by many others) established the fact that, as a general rule, the ferment factors of the stomach fail after the hydrochloric acid; and whenever there is absence of free hydrochloric acid, one may presume some diminution in the ferments as well. Consequently, in clinical practice, it has become customary to study only the acid secretion of the stomach. In the study of anæmia, the determination of the acid-secreting capacity of the stomach has become an established procedure; the finding of complete absence of acid in the stomach contents has assumed a diagnostic importance in the differentiation of the anæmias and may be of some value in their treatment.

By *achlorhydria* is meant the absence of free hydrochloric acid in the gastric juice, as judged by the production of a yellow colour, when dimethyl-amino-azo-benzol (Töpfer's reagent) is added to a specimen of the secretion. The term *achylia gastrica* was introduced by Einhorn (1892) to indicate the absence of both acid and ferment. Since the actual measurements of the ferment pepsin are rarely made in clinical practice, the terms *achlorhydria* and *achylia gastrica* have become synonymous. In this paper, we have used the term *achlorhydria* to indicate the absence of 'free' acid (di-methyl); to those cases which do not show 'free' acid even after a maximum histamine stimulus, we have given the name *true achlorhydria*; to others which do not show 'free' acid with the usual fractional oatmeal gruel test, but do so after the histamine stimulus, we have applied the term *false achlorhydria*.

**Material.**—In view of the above criteria, in a series of 418 general medical cases, we have come across 84 patients with achlorhydria. The percentage in our series works out to 20.09; and this figure agrees with that of Dhayagude and Khadilkar (1939) for Bombay. Table I. gives the classification of the cases according to the diagnosis :—

TABLE I

84 cases

| Diagnosis                    | Number of cases |
|------------------------------|-----------------|
| Anæmia .. .. .               | 79              |
| Chronic gastritis .. .. .    | 2               |
| Chronic appendicitis .. .. . | 1               |
| 'Dyspepsia' .. .. .          | 2               |

It is seen at once that the bulk of the cases is formed by the anæmia group; in fact, it was the anæmic state of these patients that necessitated their admission to the hospital for investigation. A detailed analysis of these 79 cases of anæmia, with special reference to the state of their gastric secretion, forms the basis of this communication.

**Procedure.**—In each case a detailed clinical history was taken. The blood was scrutinized minutely, recording all the absolute indices, a van den Bergh reaction, and the red cell fragility test; Wassermann or Kahn tests were done as a routine and, wherever indicated, other bio-chemical studies. A sternal marrow biopsy was done as a routine in all the cases. The urine and the faeces were subjected to a detailed examination in every case, and the faeces very carefully searched for parasitic ova. For the gastric analysis, in the first instance, a fractional oatmeal gruel test was employed and, if this displayed no 'free' acid, the procedure was repeated by the method recommended by Castle and Minot (1936); this entails the use of dilute alcohol as the test meal and histamine as the special stimulus.

**Results.**—Tables II and III show the arrangement of the cases under the headings of true and false achlorhydria and their diagnoses in detail :—

TABLE II

True achlorhydria  
44 cases

| Diagnosis  | Number of cases |
|--|-----------------|
| Pernicious anæmia .. .. .  | 13              |
| Pernicious anæmia with subacute combined degeneration of the cord. .. .. . | 6               |
| Tropical macrocytic anæmia .. .. .   | 13              |
| Idiopathic hypochromic anæmia (Witts') .. .. .                             | 5               |
| Normocytic anæmia of varied origin .. .. .                                 | 4               |
| Ankylostomiasis .. .. .  | 1               |
| Pellagra .. .. .   | 1               |
| Carcinoma stomach .. .. .  | 1               |

TABLE III

False achlorhydria  
35 cases

| Diagnosis                                      | Number of cases |
|--|-----------------|
| Tropical macrocytic anæmia .. .. .             | 31              |
| Idiopathic hypochromic anæmia (Witts') .. .. . | 1               |
| Normocytic anæmia of varied origin .. .. .     | 2               |
| Normocytic anæmia: cirrhosis liver .. .. .     | 1               |



*Discussion.*—Seven, out of the 79 cases, secreted 'free' acid when the gastric analysis was repeated with the alcohol meal without the histamine stimulus; consequently, they have been grouped under false achlorhydria. It is worth noting that 28 of the 72 cases—38.8 per cent—showed the achlorhydria to be of the false type, and the results strikingly illustrate the importance of using the histamine stimulus for the demonstration of the true inability of the stomach to secrete 'free' acid.

Pernicious anæmia contributes the largest figure to the true achlorhydria group. Cahn and von Mehring (1886) were the first to demonstrate the absence of acid in the stomach contents in pernicious anæmia. The invariable occurrence of true achlorhydria in that disease was fully established by Hurst. However, we would like to emphasize the fact that some undoubted cases of genuine tropical macrocytic anæmia do exhibit a true achlorhydria; though, owing to the small number of cases studied, we refrain from drawing any percentage figures. This is quite contrary to the usual orthodox teaching after Wills; it means that the final differentiation of tropical macrocytic anæmia from pernicious anæmia cannot be made by the gastric analysis alone. The factors that help in difficult cases—and such cases are not very rare—are (a) unequivocal signs of involvement of the central nervous system, (b) a sternal marrow biopsy, and (c) response to liver extracts. We believe that an unequivocal demonstration of the affection of the central nervous system, a preponderance of the 'hæmoglobinized' megaloblasts in the marrow fluid, and a quick and ready response to the purer brands of liver extracts (of the anahæmin type, for instance), to be in favour of the diagnosis of a case of macrocytic anæmia as pernicious.

The occurrence of true achlorhydria in idiopathic hypochromic anæmia has been observed by many workers. Witts (1930), Davis (1931) and Hartfall (1934) have shown that true achlorhydria is found in over 80 per cent of the cases. In this condition at least one can say that the impaired gastric secretion with its consequent loss of appetite, indigestion, and improper absorption of iron determines the anæmic conditions.

The increased frequency of true achlorhydria in the upper decades of life has been commented on by many (Faber and Lang, 1908; Davies and James, 1930; Bloom and Poland, 1933). It will be seen from table IV that the largest number of true achlorhydrias falls in the ages between 41 and 50.

Whether achlorhydria, *per se*, leads to any gastro-intestinal symptoms has not been definitely settled. Faber and Lang (1908) mention epigastric distension, nausea, vomiting, gases, nervous symptoms of all sorts, diarrhœa, and mucus in the stools. A more definite syndrome, ascribed to achlorhydria, is often referred to as 'gastrogenous diarrhœa', first described by

Oppler in 1895. Hurst (1923), Christian (1925), Eggleston (1931) and others believe that achlorhydria is a precursor of pernicious

TABLE IV  
True achlorhydria  
44 cases

| Ages in years | Number of cases |
|---------------|-----------------|
| 11 to 20 ..   | 1               |
| 21 to 30 ..   | 11              |
| 31 to 40 ..   | 13              |
| 41 to 50 ..   | 15              |
| 51 to 60 ..   | 4               |

anæmia, combined sclerosis, chronic arthritis and carcinoma stomach. Table V shows the prevalence of the gastro-intestinal symptoms in our cases:—

TABLE V  
79 cases

| Symptom                                 | True achlorhydria | False achlorhydria |
|---|-------------------|--------------------|
| Total cases ..                          | 44 cases          | 35 cases           |
| Stomatitis or a previous history of it. | 15                | 10                 |
| Loss of appetite                        | 4                 | 9                  |
| Vomiting ..                             | 3                 | 5                  |
| Diarrhœa or a previous history of it.   | 7                 | 10                 |

In assessing the significance of achlorhydria with anæmia, one has to be very particular in considering which of the conditions—lack of acid or anæmia—is the primary. Apperly (1936) states that when the red blood cell count is about half the normal figure, 'free' acid disappears from the stomach. Alvarez and Carlson (1936) found that when the hæmoglobin falls below 75 per cent free acidity is reduced. McRobert, Reddy and Subramaniam (1940) record recoveries from histamine-fast achlorhydria with improvement in the associated anæmia. However, no definite conclusions can be drawn, for the present, regarding the production of any ill-effects by the achlorhydria, though most clinicians agree to the exhibition of hydrochloric acid in promoting recovery.

#### Summary

(1) An analysis of 79 cases of achlorhydria is given.

(2) It is stressed that the histamine stimulus must always be employed to distinguish true from false achlorhydria.

(3) It is pointed out that some cases of tropical macrocytic anæmia do exhibit true achlorhydria.

(Concluded on opposite page)

## LUNG SYPHILIS

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Most of the textbooks of medicine and roentgenology begin the article on lung syphilis by the statement that a syphilitic lung affection in adults is a rarity (Boyd, 1935; Price, 1937; Sante 1936; Shanks, Kerley, and Twining, 1938, and Tice, 1929). Looking through the literature one finds a great variety of opinions on the question of how frequently an acquired pulmonary syphilis may be safely diagnosed. Whereas the well-known autopsy figures of Osler (1916), Symmers (1916) and Claytor (1905) seem to prove the extreme rarity of a syphilitic lung affection, some clinicians, such as Karschner and Karschner (1920), Munro (1922) and Watkins (1921), believe that this form of visceral lues is far more common than is usually assumed. An important step towards the solution of this clinical-pathological problem was the formulation of five conditions by

(Continued from previous page)

I thank all my colleagues at the hospital for their co-operation; to Dr. J. C. Patel, especially I am grateful for constant help and many suggestions. I also thank Dr. R. Row, M.D., D.Sc. (Lond.), the Director of our hospital, for the permission to publish this paper, and much guidance in its preparation.

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Howard (1924) which, in every case of supposed lung syphilis, have to be fulfilled before the diagnosis is generally acceptable:—

1. Chronic lung affection with disproportion between grave physical signs and the much less affected general condition.

2. Constant absence of tubercle bacilli in the sputum.

3. History of syphilitic infection with positive Wassermann reaction.

4. Another syphilitic manifestation apart from the lung process.

5. Response to anti-syphilitic treatment.

The only way for the individual clinician or hospital to help in deciding the still open question, of how frequently acquired lung syphilis occurs among chronic lung affections, is the publication of every case where the diagnosis of pulmonary syphilis seems almost certain, according to the standardized criteria.

One more reason for reporting the following case is the fact that in the literature available to us no case of lung syphilis has previously been reported from India.

## • Case history

A Hindu ryot belonging to the Sudra caste, age about 40 years, was admitted into our hospital, seeking relief for two apparently quite different complaints. Four years ago there began a cough, mostly dry, occasionally producing some scanty expectoration, disturbing his night's rest and accompanied by an increasing dyspnoea during most of the past year. One month prior to admission a severe pain began in his shoulders and arms, soon becoming excruciating in intensity during the night; a quickly increasing weakness of the arms, which not only made agricultural labour impossible but even prevented him from feeding himself without the help of others (as he could not lift the hands to the mouth), compelled him to seek admission. There was no fever at any time of his illness and none for years previous to it. About ten years prior to admission, six years before the cough began, the patient contracted a venereal disease, described by him as a sore on the penis and painless swelling of the inguinal glands.

*Examination on admission* (5th November, 1940) revealed the following principal facts: a dark man of moderate build, apparently somewhat reduced in weight but not cachectic, able to move about, supporting his arms to alleviate the pain.

*Cerebral nerves*.—No abnormality, pupils reacting to light and accommodation.

*Fundus*.—No pathological signs.

*Chest*.—Left side of anterior chest-wall substantially, left posterior chest-wall, to a lesser degree, flattened; respiratory movement considerably diminished on the left side, more on the front than on the back. Movement on right side free.

*Lungs*.—Left side: The supra- and infra-clavicular regions down to the fourth intercostal space showed a hard, wooden dullness on percussion; supra- and infra-spinous fossæ dull to percussion, but to a much lesser degree; respiratory murmur very loud and bronchial in the dull region; adventitious sounds completely absent, even after coughing; vocal resonance and vocal fremitus considerably increased. No stridorous breathing.

*Heart*.—Not enlarged on percussion, normal configuration; apex beat slightly outwardly displaced, just in the mid-clavicular line, in the fifth intercostal space; over all ostia two clear sounds, no accentuation, no murmur; vessel-band apparently not enlarged; no abnormal pulsation. Pulse rate 92. Blood pressure 130/75.

*Electrocardiogram*: Low voltage. In lead IV R almost absent, T flat; moderate heart muscle-lesion.

Liver and spleen not enlarged.

Both the deltoid muscles and the muscles of the arms innervated by the fifth and sixth cervical wasted and showed diminished motor strength and loss of tone; sensory disturbances confined to the same area of the fifth and sixth cervical as shown by complete loss of sensation to touch, pain, hot and cold stimuli bilaterally over the lateral aspect of shoulder and upper arm, the radial side of the forearms, thumbs and index fingers. Biceps-, supinator- and pronator-jerks lost; triceps-jerks brisk. Triceps and the small muscles of the hands did not show any change; abdominal- and cremaster-reflexes normal as well as knee- and ankle-jerks; the lower extremities free from pathological signs.

Temperature was normal throughout his stay at the hospital and never exceeded 98.5°F. except after the first Bisoxyl injection.

*Sputum*.—Tubercle bacilli not found (concentration method): neither spirochaetes, spirilla, mycelial threads, nor spores of fungi present; elastic fibres absent. The sputum examination was repeated seven times on 5th, 9th, 16th November, 5th, 23rd, 31st December, 1st January, always with the same negative result. The sputum was so scanty that we had to stimulate expectoration to get enough for examination; it was never rusty, hæmorrhagic or foul smelling.

5th November, 1941.—Leucocytes—5,900. Differential picture: polymorphonuclears—76 per cent, lymphocytes—23 per cent, eosinophils—1 per cent.

28th November, 1940.—Leucocytes—6,200.

8th December, 1940.—Leucocytes—6,400.

*Tuberculin-reaction*.—1/10,000 mg. i.d. negative, 1/1,000 mg. slightly positive.

*Blood*.—Wassermann reaction + + +, Kahn + +, Kline + +.

*Spinal fluid*.—Clear, colourless, Nonne-Apelt negative, cells 3/c.mm., Wassermann reaction negative.

Our first tentative diagnosis was malignant tumour of the left upper lung lobe with secondaries in the spinal column affecting the roots of fifth and sixth cervical, though the duration of the complaints seemed too long for a malignant growth. But the radiological examinations changed our opinion.

The frontal and lateral radiograms of the cervical spinal column were normal.

The first radiogram of the chest (plate III, figure 1, 6th November, 1940) showed a dense heterogeneous opacity which occupies the whole upper lobe including the apical region, the outlines not sharp, 'mossy' (Watkins, 1921); a dense peribronchial-perivascular structure radiates from the left hilum in the opaque region branching to an irregular network in the infra-clavicular part. Neither finger-like structures nor a sharp or a polycyclic outline is visible anywhere. The right side shows the lung tissue entirely free from any pathological signs; the lower part of the right hilum is slightly increased. Trachea, mediastinum and heart are pulled to the left side. On screening, the mediastinum shows no pathological movements. The diaphragm moves freely on both sides.

*Radiological summary*.—Diffuse infiltration of the whole left upper lobe with peribronchitis and displacement of trachea, mediastinum and heart to the left. Peribronchitis in the right hilum, radiating in the right lower lobe.

The diagnostic considerations excluded first fibro-caseous tuberculosis, from the fact that the right lung was entirely free in spite of four years' duration of the clinical process, that adventitious

sounds were entirely absent, temperature normal and tubercle-bacilli in the sputum absent. There was no reason to suspect a mycotic infection, as neither the clinical picture nor the appearance of the sputum nor its microscopical examination showed any symptoms of mycosis. The diagnosis of a tumour was improbable, in spite of our first suspicion, as none of the protean tumour symptoms were present in the radiogram. Neither the physical signs (showing loud bronchial breathing with increased vocal fremitus and resonance) nor the x-ray appearance were those of a massive collapse. We had to be content with the diagnosis of an interstitial proliferative process with a subsequent fibrosis and peribronchitis. As tuberculosis, which is the usual reason of this condition, was most improbable in our case and a unilateral pneumoconiosis does not exist, there remained two possibilities: an unresolved pneumonia leading to carnification and fibrotic shrinking (improbable from the patient's history and the clinical signs) or a syphilitic interstitial infiltration (Assmann, 1922).

*Treatment*.—As the patient had contracted a syphilitic infection ten years ago and the serological reactions were strongly positive for syphilis, we decided to start with anti-syphilitic treatment, giving him no other remedies than Bisoxyl twice a week, Mapharside 0.04 to 0.06 once a week and occasionally a dose of an expectorant to get sputum enough for examination. We expected a good effect from this treatment on the radiculitis and hoped for some influence on the lung condition. Our expectations were satisfied regarding the first, but far surpassed on the second point.

The first Bisoxyl injection (9th November, 1941) caused a rise of temperature to 100°F. without any focal reactions; but the first and second Mapharside doses were followed by unbearable pains in shoulders, arms and left side of the chest with increased dyspnoea. The man tearfully implored the duty-doctor to alleviate his suffering; as barbiturates and pyramidon combinations in large doses failed, morphine-atropine injections had to be given to control these reactions.

The further development proved very soon that these exacerbations of pain were due to specific focal reactions. All pains subsided completely after 12 days of anti-syphilitic treatment; the objective signs of radiculitis, such as wasting and hypotony of the affected muscles, sensory disturbances and weakness of the arms disappeared gradually within five weeks of bismuth and Mapharside medication and even the biceps-jerks reappeared in the sixth week, so that the diagnosis—'syphilitic cervical radiculitis'—became almost certain.

Examining the lung twice daily we got the impression that the intensity of the dullness and the loudness of the bronchial breathing were slightly diminished two days after the second Mapharside reaction, 14 days after the anti-syphilitic treatment was started; this clinical improvement was soon, beyond any doubt, confirmed by the radiogram taken after four weeks of specific medication (plate III, figure 2, 6th December, 1940); the lower half of the left upper lobe became almost clear, the opacity of the left apical region diminished; the peribronchial infiltration, fan-like, converging to the left hilum, was still very marked; the right hilum appeared heavier. The deviation of the trachea, the displacement of the mediastinum and the heart were somewhat reduced.

We have to stress the point that this process of quick improvement was not accompanied by increased cough or expectoration; the lung consolidation did not vanish by expectoration but by resorption only. Twenty-three days after the beginning of the treatment cough and expectoration subsided entirely; the improvement went on much more quickly than in the beginning; the flattening of the chest-wall appeared less definite, the respiratory excursions increased, the dullness melted away and the bronchial breathing was replaced gradually by harsh vesicular breath sounds. The radiograms taken twelve days and twenty-seven days later, respectively (plate III, figure 3, 19th December, plate III, figure 4, 2nd January, 1941), show the clearing of the interstitial infiltration and the considerably reduced peribronchial and perivascular thickening. The patient felt so well that we were unable to keep him longer in spite of the fact that the W. R. was still +++ positive; Kahn and Kline ++. Eight weeks after admission he resumed the hard work of the South Indian peasant.

We advised his nearest dispensary to continue the anti-syphilitic treatment and to send the patient for control every month. As he did not appear for four months, one of us (Krishnaswami) went up-country to seek him. After several attempts he found our patient and brought him, his wife and his daughter to the hospital. The wife's blood W. R. +++, Kahn and Kline ++ positive. Her child, a girl of ten, resembled in her mental development a child of five; she showed a saddle-nose and Hutchinson's teeth; her blood gave a W. R. +++, Kahn and Kline ++ positive. These signs of congenital syphilis enabled us to confirm the statement made by our patient regarding the time of his infection.

The man had received only 6 bismuth injections during the four months since he had left the hospital. About one month ago a slight weakness and numbness in the right arm began to trouble him again; he did not feel any dyspnoea, there was no fever, no cough, no expectoration and hardly any discomfort in the chest. The clinical examination showed no definite pathological signs in the lungs; however we got the impression that the right infra-clavicular region was slightly duller to percussion, the breath sounds there somewhat harsher than on the left, the previously extensively damaged side. Temperature, pulse and respiration were normal. In the right arm an upper plexus type (Erb-Duchenne) of brachial plexus neuritis was present, though the symptoms were much milder than on the first admission and confined to the right side.

Radiogram of the chest (plate III, figure 5, 6th May, 1941) showed that the healing process in the left lung had progressed still further, so that this side looked almost normal; whereas the lower part of the right hilum showed very

definite peribronchial thickening and looked much heavier than before; the most interesting change was a broad band in the basal part of the right upper lobe; it was of a high density and rather sharp in outline like a fibrous streak.

#### Laboratory findings

*Urine and stool.*—Nothing abnormal.

*Sputum* (after using expectorants).—Very scanty. Neither tubercle bacilli nor elastic fibres nor spirochaetes present.

*Blood examination.*—Leucocytes—9,800. Differential picture: polymorphonuclears—80 per cent, lymphocytes—14 per cent, eosinophils—6 per cent. Hæmoglobin (Sahli)—62 per cent.

*Sedimentation rate.*—10 mm.

Wassermann reaction + + +, Kahn and Kline reaction + + positive.

Under intensive anti-syphilitic treatment the symptoms of upper brachial plexus neuritis showed a definite exacerbation lasting for twelve days; the following two weeks of continued bismuth and Mapharside injections brought about a perfect cure of all neurological signs.

The improvement of the lung condition is seen in the radiogram which was taken one month after the second admission (after 9 bismuth and 4 Mapharside injections) (plate III, figure 6, 6th June)\*; the broad band-shaped opacity had disappeared; two thin strips of peribronchial thickening marked its former localization. The thickening of the right hilum was equally reduced. At this time the W. R. was only + positive, Kahn and Kline ±.

A few days later the anti-syphilitic treatment had to be stopped because the patient developed a very extensive ulcerative bismuth-stomatitis and glossitis; it took ten days of a combined treatment with vitamin C, nicotinic acid and liver-extract injections to cure this distressing condition.

One week later the patient felt so strong and well that we could not persuade him to stay longer; though he got only 2 bismuth and 1 Mapharside injection since the last radiogram (plate III, figure 6) was taken, the improvement continued, as seen in the next radiogram (plate III, figure 7, 1st July); it shows that a sharp strip not broader than a knife-edge in the base of the right upper lobe is all that remained from the fresh infiltration on the right side. The serological reactions, five weeks after the second admission, were W. R. negative, Kahn and Kline R. negative. A fortnight later after one more Mapharside injection, the last trace of the right side infiltration had disappeared (plate III, figure 8, 15th July).

The patient was re-admitted on the 20th November, 1941. The clinical examination did not reveal any pathological signs in lungs and nervous system. The radiogram of the lungs

\* We tried several times to do a bronchography with lipiodol, but we failed because of the patient's lack of co-operation.

showed the same slight fibrosis in left upper lobe and slight displacement of the mediastinum to the left side as seen in the radiogram (plate III, figure 8); the whole of the right side was free from any pathological sign.

Wassermann reaction, Kahn and Kline tests were negative.

The patient feels perfectly well and has gained 8 lbs. in weight.

### Discussion

The clinical, radiological and serological observations prove that our diagnosis of a syphilitic lung lesion and the radiculitis were right. The diagnosis of acquired tertiary lung syphilis is further confirmed by the full accord between the reported facts and Howard's (1924) five points:—

1. A pulmonary affection, lasting for at least four years, showing a disproportion between the extensive objective signs and the comparatively mild subjective symptoms.
2. Absence of tubercle bacilli in the sputum in eight consecutive examinations.
3. History of syphilitic infection ten years previously and highly positive Wassermann, Kahn and Kline reaction.
4. Cervical radiculitis as a syphilitic manifestation apart from the lung process.
5. The quick and complete response of the pathological processes in the nervous and respiratory system to anti-syphilitic treatment.

That the lung signs in our case were not due to a syphilitic lesion of a bronchus with narrowing of its lumen is beyond doubt, from the clinical and radiological findings.

The pathological process in the left upper lobe was an infiltration, most probably peribronchial and perivascular; whether a true syphilitic 'gelatinous' (Stanley, 1911) pneumonia had developed is difficult to decide; the fact that the displacement of the mediastinum with trachea and heart to the affected side was reversible to some extent, proves that it was not due to a fibrosis only but to an extensive atelectasis of lung tissue by compression either from the interstitial infiltration or from a syphilitic 'broncho-pneumonia', which produces intra-alveolar specific cell-proliferation and fibrino-cellular exudate of patchy distribution with partial collapse of the unaffected areas. The residual displacement of the mediastinum is due to a fibrosis which is the cicatrization state of previous infiltration.

The radiological appearance of the fresh process in the right upper lobe before and after treatment makes the pathological diagnosis 'interstitial (peribronchial, perivascular) infiltration' almost certain.

The radiological classification of our case according to the system which Assmann (1922) put forward tentatively and which was generally accepted since is not difficult. Assmann (*loc. cit.*) states: 'most frequently one observes *interstitial processes*, progressing in the peribronchial and inter-lobular connective tissue, along the lymph vessels and sinuses; they penetrate the lung, radiating from the

hilum and tend to shrinking cicatrization'. One cannot give a description better fitting our series of radiograms; the first stage is seen in the right upper lobe (plate III, figures 5 to 8), the full development in the left upper lobe (plate III, figures 1 to 4).

It is certainly wrong to postulate the right side or the middle zone and the lower parts of the lung as the characteristic localization of the lung syphilis as is done by some radiologists. In Allison's (1929) case the luetic process affects the left upper lobe, in Hartung and J. Freedman's (1932) first case it is scattered through both the lungs; the second shows a solitary gumma in the left lower lobe similar to the case described by Denman (1932). E. Freedman and Higley (1934) report a gumma of the right lower with atelectasis of the middle lobe. In Robinson's (1935) case the left upper and lower lobes have been involved. The radiogram reproduced by Twining shows a diffuse infiltration of the middle and basal third of the left lung and a dense opacity with sharp outlines in the right middle zone. Wigby and Sander's (1935) case, though clinically incomplete, was verified by necropsy; with microscopic examinations it was a gumma in the right upper lobe. In Pearson and de Navasquez's (1938) observation autopsy revealed a gummatous-fibrotic process in the middle third of the right lung, comprising the lower part of the upper and the upper parts of the middle and lower lobes: the same case showed further a syphilitic pneumonia in the middle third of the left lung, which occupied the lower part of the upper and the upper part of the lower lobes. None of these cases show an involvement of the whole apical region as seen in our radiograms.

### Conclusion

Howard's five points are very useful in making certain the diagnosis of acquired lung syphilis, if a histological confirmation is not available. The first stage of tertiary syphilitic lung lesion in the described case is an interstitial peribronchial infiltration. Interstitial infiltration, shrinking fibrosis and probably specific pneumonic exudation might be found at the same time, as different stages of the same pathological process. Displacement of mediastinum, trachea and heart is shown to be reversible in as much as it is not due to fibrosis but to partial atelectasis.

Acquired lung syphilis may be localized in any part of the lung; neither one side nor one lobe seems to be more frequently affected than another.

### Summary

A case is reported of tertiary syphilitic lung infiltration involving the whole left upper lobe which was clinically almost cured after seven weeks of anti-syphilitic treatment. Four months

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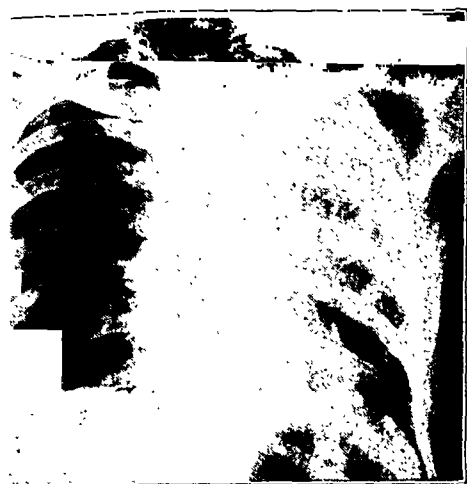


Fig. 1.—6th November, 1940. Opacity of the left upper lobe. Mediastinum displaced to the left.



Fig. 2.—6th December, 1940. Clearing of basal part, left upper lobe.

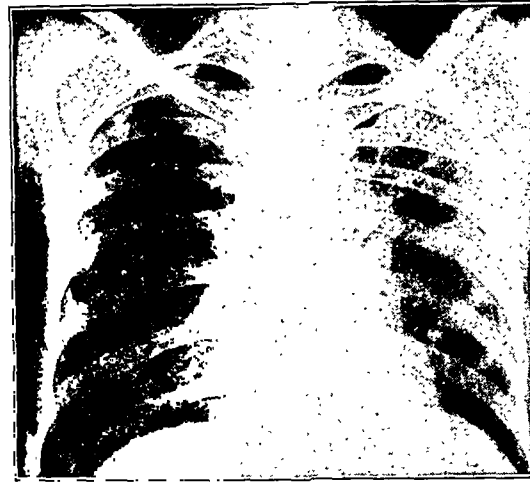


Fig. 3.—19th December, 1940. Further clearing

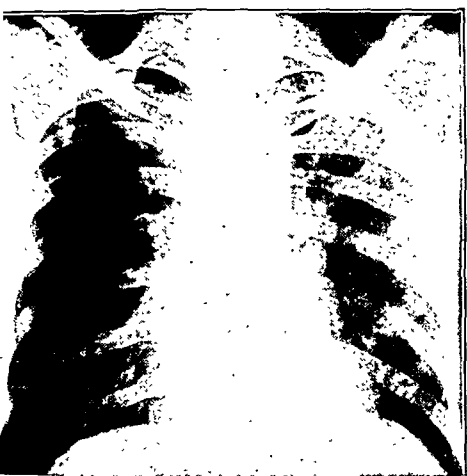


Fig. 4.—2nd January, 1941. Left upper lobe almost clear. Mediastinum displacement reduced.

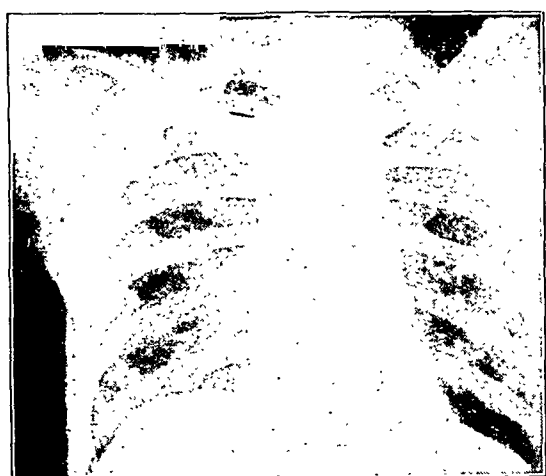


Fig. 5.—6th May, 1941. Peribronchial infiltration in basal part of right upper lobe and in the right hilum.



Fig. 6.—6th June, 1941. Infiltration reduced to two thin strips.

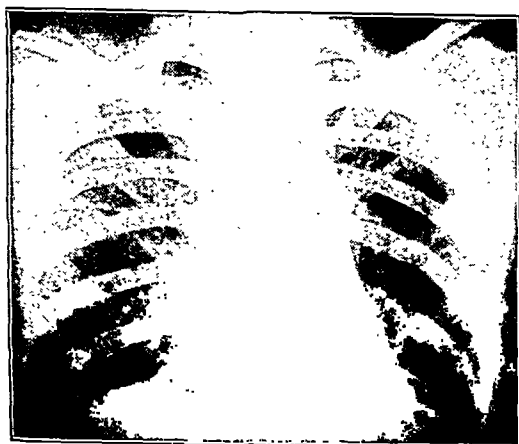


Fig. 7.—1st July, 1941. One sharp thin strip is left.



Fig. 8.—15th July, 1941. Infiltration in right upper lobe has disappeared.



Fig. 1.—Showing the condition of the incisors of the rat before treatment with the water from Nagercoil.



Fig. 2.—Showing the appearance of pitting on the lower incisors by the 18th day of the above treatment.



Fig. 3.—Showing the rapid development of the pitting (mottling) of the lower incisors as on the 28th day of treatment.

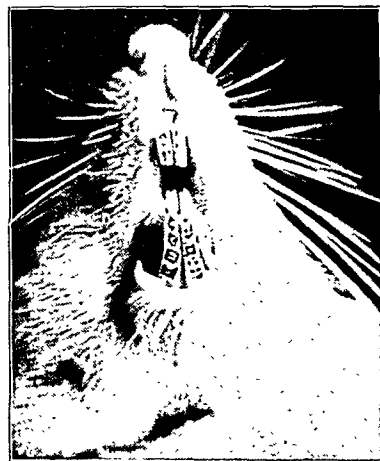


Fig. 4.—Showing the advanced stage of mottling as after a month; the upper incisors are also being affected.

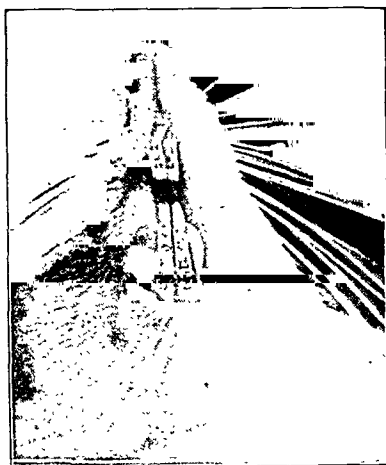


Fig. 5.—Showing the stage of recovery from the external symptom of pitting consequent on stopping the treatment with the Nagercoil water (after a month).



Fig. 6.—Showing the rapid disappearance of the symptom of pitting as after three months.



# FURTHER OBSERVATIONS ON THE MOTTLED ENAMEL IN NAGERCOIL

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IN a previous communication (Pillai, 1938), it was reported that a section of people who use the water from a public well in a certain locality in Nagercoil (S. India) suffered from mottled enamel. Later, it was of interest to make the further observation that only those who had used this water continuously from their

(Continued from previous page)

later a control examination revealed a peri-bronchial infiltration in the right upper lobe which disappeared after four weeks of intensive anti-syphilitic treatment.

The lung process was accompanied by a cervical radiculitis, which healed, reappeared and healed again in strict parallelism with the lung manifestations of syphilis.

Our thanks are due to Dr. J. F. Robinson, M.D., F.A.C.S., F.R.C.S.E., medical officer, Sri Krishnarajendra Hospital, Mysore, to our radiologist, Dr. A. C. Devaraj, and his assistant, Dr. Mohamed Aga.

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childhood were affected. Thus, such of those residents of the locality who happened to settle down there after having spent their early years (up to about ten years) elsewhere were not visibly affected by the use of the local well water. It would appear that mottling takes place during the formative period of the teeth, at any rate under the conditions obtaining at Nagercoil. With a view to studying the nature and extent of mottling under these conditions, experiments were carried out with rats. The water was further analysed for other mineral constituents, and the results are given in the table.

TABLE

The mineral composition of the Nagercoil well water

(results expressed in parts per 100,000)

|  |        |    |    |       |
|--|--------|----|----|-------|
| Silica (SiO <sub>2</sub> )   | ..     | .. | .. | 10.04 |
| Iron and aluminium oxides (Fe <sub>2</sub> O <sub>3</sub> & Al <sub>2</sub> O <sub>3</sub> ) | Traces |    |    |       |
| Calcium (Ca)   | ..     | .. | .. | 6.00  |
| Magnesium (Mg)   | ..     | .. | .. | 2.01  |

*Animal experiments with the Nagercoil well water.*—Albino rats (about 5 weeks old) were used for the experiments. As far as possible animals of the same litter were used; two or more rats from each litter were used for the experiments, while a corresponding number of about the same weight were kept as the control set. The experiments being designed primarily to elucidate the effect of fluoride-containing water on the production of mottled condition, the diets were otherwise made adequate. In both the sets of experiments, the animals were placed on a diet including mixed cereals, legume, yeast, casein, minerals and, more important, fat-soluble vitamins (in the form of cod-liver oil). The only difference between the experimental and the control diets was that, whereas the former was made up with fluoride-containing water from Nagercoil (the animals also were given the same water to drink), the controls were given fluoride-free water. The growth rates of the animals as well as the conditions of the teeth from time to time were studied.

*Observations.*—It was observed that, during a period of 13 weeks, there was practically no significant difference between the growth rates of the experimental and control animals. On the other hand, there was a striking difference in regard to the conditions of the teeth. These observations are illustrated in plate IV, figures 1 to 6; also figure 7. It may be observed that in about a month the mottled conditions reached an advanced stage and was clearly visible on the lower and upper incisors. This condition continued during the subsequent period so long as the animals were given the same water.

*Effect of change of water on the mottled condition.*—After the dental defect had reached the advanced stage, some of the experimental



animals were changed over to the control diet. It was observed that they recovered slowly, and by about the 90th day the external symptom of the mottled condition disappeared almost completely.

Teeth formation in rats commences at a much earlier stage than in the ones used in the present experiments, so that it is possible, in the case of slightly older rats which were employed, there developed a reversible type of mottled condition which could be relieved considerably by changing over to fluoride-free water.

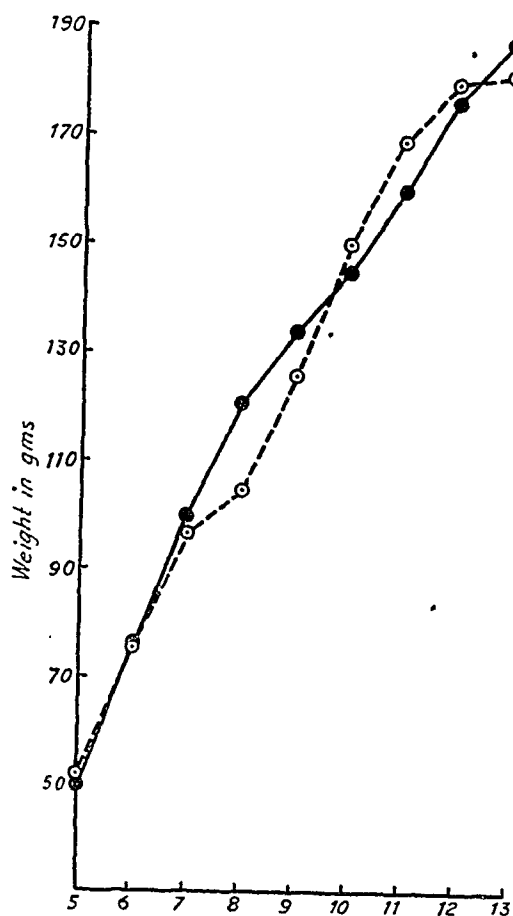


Fig. 7. Age of rats in weeks.

●—● Experimental  
○--○ Control

*Attempts to check the development of mottled condition in rats.*—A preliminary series of experiments was carried out with another batch of animals in three sets which were given the same basal diet but were given in addition (a) water containing fluoride in quantities corresponding to that observed in the Nagercoil water, (b) the same water as used in (a) plus calcium hydroxide in sufficient quantities to precipitate the fluoride as the calcium salt, and (c) water free from fluoride. The growth rates of the animals and also the condition of the teeth were examined from time to time (figure 8).

It was observed that, as in the case of the previous experiments, there was no significant difference between the growth rates of the experimental and control rats; and there was, however, no difference between the rats in the series (a) and (b) in relation to their mottled condition.

*Conclusions.*—In the case of humans, the development of the mottled condition through drinking fluoride-containing water (at any rate under the conditions prevailing in Nagercoil) appears to take place predominantly during the formative period of the teeth.

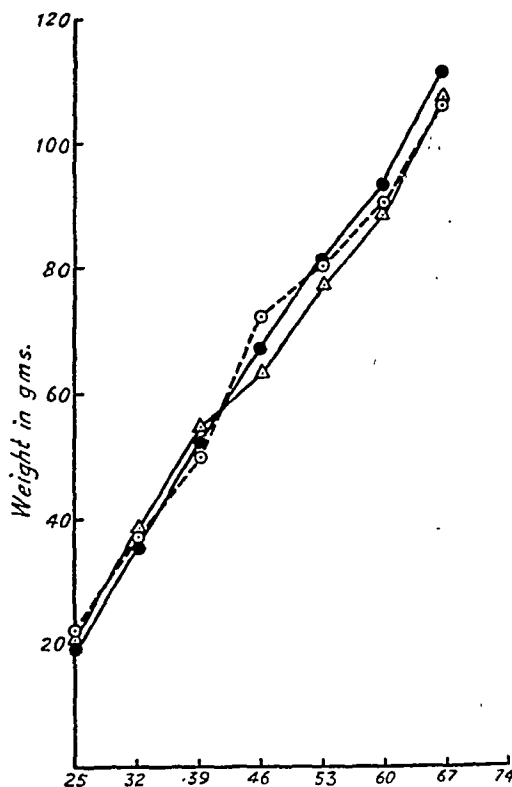


Fig. 8. Age of rats in days.

●—● Experimental  
△--△ Ca (OH)<sub>2</sub> added  
○--○ Control

Experiments with 5 weeks old rats led to the production of a reversible type of mottled condition when fluoride-containing water was given to rats. The symptoms developed very rapidly and reached an advanced condition in about a month. On changing over to fluoride-free water, however, there was considerable recovery in about 90 days.

Addition of calcium hydroxide to water in quantities calculated to precipitate the fluoride does not seem to be efficacious in checking the incidence of the mottled condition in rats.

The author thanks Professor V. Subrahmanyam for his kind interest in this work.

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# A STUDY OF THE NORMAL BLOOD PRESSURE IN INDIANS

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*Introductory.*—So far as we know the standards of blood pressure for normal individuals in this country have not been worked out. The standards that are commonly referred to for medical and insurance purposes are not based on data collected in this country, but have been borrowed from the records of foreign insurance companies. The present study was carried out on 10,000 persons from different parts of India. Every attempt was made to select healthy and normal individuals between the ages of 15 and 80 years, from both the rural and the urban populations. The blood pressure was taken by means of a mercury baumanometer, the auscultatory method being employed to take the readings. The diastolic reading was taken at the point when all sounds disappeared. The ten thousand cases under investigation consisted of both males and females, and individuals belonging to different communities, religions and climatic zones. Thus, there were 8,105 males and 1,895 females. There were 3,550 Hindus, 3,365 Muslims, 1,690 Sikhs, 1,195 Christians and 200 Persians and Afghans. From the standpoint of climates, three main geographical regions, the north, east and south of India, were selected. There were thus 5,146 cases from the Punjab, Delhi and the United Provinces, and 714 cases from Nepal and other hilly areas; 3,522 cases were from Bengal, Bihar and Orissa, and 618 cases from Madras. An attempt to establish the average systolic and diastolic pressure of Indians, taking all these factors into consideration, and also the effect of age and diet on blood pressure, is the main object of this paper. Our findings are recorded in the tables.

In view of the fact that a comparison of these figures with those obtained in Europeans in similar age-ranges is important, table II, worked out by Symonds in 1923, is quoted.

The most prevailing systolic blood pressure amongst Indians ranges between 110 and 119 mm. Hg., 33.1 per cent against 17.0 per cent only for Europeans for the same range of pressure. The next commonest group amongst Indians consists of persons with systolic pressures between 100 to 109 mm. Hg., 20.6 per cent against only 3.5 per cent for Europeans. The majority of Europeans have higher systolic pressures than Indians. Thus, for the ranges of

systolic pressure between 120 and 129 and 130 and 139 mm. Hg., relative frequency amongst Europeans is 31.3 and 23.3 per cent against 20.3 and 12.6 per cent for Indians. There were 78.6 per cent Indians who had their systolic

TABLE I

*Showing systolic, diastolic and pulse pressure means of Indians when worked out according to different age-ranges*

| Age-range<br>years | Systolic<br>pressure,<br>mm. Hg. | Diastolic<br>pressure,<br>mm. Hg. | Pulse<br>pressure,<br>mm. Hg. |
|--------------------|----------------------------------|-----------------------------------|-------------------------------|
| 15-19 .. ..        | 109.2                            | 70.0                              | 39.2                          |
| 20-24 .. ..        | 111.5                            | 72.4                              | 39.1                          |
| 25-29 .. ..        | 112.0                            | 71.2                              | 40.8                          |
| 30-34 .. ..        | 113.6                            | 72.0                              | 41.6                          |
| 35-39 .. ..        | 118.6                            | 72.6                              | 46.0                          |
| 40-44 .. ..        | 120.4                            | 73.2                              | 47.2                          |
| 45-49 .. ..        | 122.8                            | 75.0                              | 47.8                          |
| 50-54 .. ..        | 126.2                            | 77.1                              | 49.1                          |
| 55-59 .. ..        | 126.4                            | 80.4                              | 46.0                          |
| 60-64 .. ..        | 128.0                            | 82.5                              | 45.5                          |
| 65-69 .. ..        | 128.6                            | 82.8                              | 45.8                          |
| 70 and above ..    | 130.2                            | 83.0                              | 47.2                          |

TABLE II

*Showing systolic, diastolic and pulse pressure means of healthy Europeans and Americans, when worked out according to different age-ranges*

| Age-range<br>years | Systolic<br>pressure,<br>mm. Hg. | Diastolic<br>pressure,<br>mm. Hg. | Pulse<br>pressure,<br>mm. Hg. |
|--------------------|----------------------------------|-----------------------------------|-------------------------------|
| 15-19 .. ..        | 123.5                            | 79.5                              | 40.0                          |
| 20-24 .. ..        | 124.2                            | 80.5                              | 43.7                          |
| 25-29 .. ..        | 124.5                            | 81.5                              | 43.0                          |
| 30-34 .. ..        | 125.1                            | 82.3                              | 42.8                          |
| 35-39 .. ..        | 125.3                            | 83.3                              | 42.0                          |
| 40-44 .. ..        | 126.4                            | 84.0                              | 42.4                          |
| 45-49 .. ..        | 128.2                            | 84.7                              | 43.4                          |
| 50-54 .. ..        | 130.2                            | 85.9                              | 44.3                          |
| 55-59 .. ..        | 133.5                            | 86.8                              | 46.7                          |
| 60 and above ..    | 135.2                            | 86.9                              | 48.3                          |

blood pressure below 129 mm. Hg. as compared with 52.9 per cent for Europeans. In cases of higher ranges of blood pressure, i.e., 130 to 170 mm. Hg., there were more Europeans, 47.1 per cent as compared with 21.4 per cent of Indians.

The average diastolic pressure of Indians ranges between 70 and 83 mm. Hg. This is 6 to 10 mm. Hg. lower than in Europeans but the difference is not so marked as in the case of the systolic pressure. The pulse pressure of Indians is also lower than that of Europeans. From 35 to 55 years of age this shows a sudden rise, followed by a subsequent fall.

In table III the systolic, diastolic and pulse pressures of three groups of Indians have been compared with those of Europeans.

TABLE III

*Showing the comparative systolic, diastolic and pulse pressure means of Europeans and different types of Indians*

| Race and climates  | Average systolic pressure, mm. Hg. | Average diastolic pressure, mm. Hg. | Average pulse pressure, mm. Hg. |
|--|------------------------------------|-------------------------------------|---------------------------------|
| Indians as a whole ..  | 115.2                              | 76.0                                | 39.2                            |
| People belonging to the Punjab, the U. P. and Delhi Provinces. | 116.2                              | 76.4                                | 39.8                            |
| People belonging to Bengal, Bihar and Orissa Provinces.        | 114.7                              | 76.2                                | 38.5                            |
| People belonging to Madras and Southern India.                 | 115.0                              | 75.2                                | 39.8                            |
| Europeans ..   | 125.3                              | 85.0                                | 40.3                            |

It will be observed that the average systolic pressure of northern Indians is somewhat higher than of eastern and southern Indians, 116.2 mm. Hg. against 114.7 and 115 mm. Hg., respectively. The average systolic pressure of Indians as a whole is 10.1 mm. Hg. less than that of Europeans. The average diastolic pressure is less variable amongst different Indian races but in the case of the Europeans, it is 9 mm. Hg. higher than in Indians. The variations in pulse pressure are relatively less marked. From the above findings it appears that the northern Indians hold an intermediate place in blood pressure between Europeans and Indians from the east and south.

*Effect of diet on blood pressure.*—It is an established fact that diet exerts a considerable influence on blood pressure and hyperpiesis is more frequent amongst heavy meat-eaters than amongst vegetarians. Though this hypothesis allows many exceptions it was deemed interesting to analyse this point. Accordingly, comparative blood pressure was recorded from people on mixed diet and people strictly vegetarian. The following table represents these findings :—

TABLE IV

*Showing the effect of diet on blood pressure of Indians*

| Diet                    | Average systolic pressure, mm. Hg. | Average diastolic pressure, mm. Hg. | Average pulse pressure, mm. Hg. |
|-------------------------|------------------------------------|-------------------------------------|---------------------------------|
| People on mixed diet .. | 118.7                              | 72.3                                | 46.4                            |
| Vegetarians ..          | 116.2                              | 72.5                                | 43.7                            |

It will be seen from this table that people on a mixed diet have slightly higher systolic and pulse pressures than those on pure vegetarian diet, the differences being at least 2.5 mm. Hg. for the systolic pressure. The diastolic pressure is almost identical in both these groups.

*Blood pressure in females.*—Blood pressure in females could not be so thoroughly studied as in the male. It was, therefore, difficult to place them in the tables above. The amount of data collected in Symond's table and also by ourselves showed that the average systolic pressure in European females between the ages of 15 and 70 years was roughly about 127.6 mm. Hg. against 115.4 mm. Hg. in Indian females. The average systolic and diastolic pressures in Indian females on a mixed diet were 115.4 and 70.2 mm. Hg., respectively, whereas those in vegetarians were 110.2 and 68.2 mm. Hg.

*Summary and conclusions.*—The figures available in this country regarding standard blood pressure for Indians have been controversial. It was, therefore, considered advisable to undertake this survey along with the field work in connection with Drug Addiction Inquiry. The authors have examined ten thousand healthy Indians of all ages, sexes and castes from different parts of the country. Many of these cases were under observation from time to time for several years.

From the data we have collected, the following tentative conclusions can be drawn :—

1. The average systolic pressure in Indians is lower than that in Europeans. For any age-range previously enumerated this difference varies from 5 to 14 mm. Hg. About 53.7 per cent of Indians have their systolic pressure between 100 and 119 mm. Hg. against 20.5 per cent Europeans for the same range. For higher ranges, e.g., 120 to 139 mm. Hg., the percentage of Europeans increases up to 54.6 against 32.9 only for Indians.

2. The average diastolic pressure of Indians is also lower than that of Europeans. This is approximately 8 to 9 mm. Hg. less. The pulse pressure naturally is also proportionately low but between the ages of 35 to 60 years it attains almost the same height as in Europeans.

3. Amongst the various communities in India, it has been found that the people of the north (Punjab, U. P. and Delhi) do have higher systolic and diastolic pressures than the people of the east (Bengal, Bihar and Orissa) and south (Madras). The bracing climate of the north, better diet and higher standard of living would possibly account for this difference.

4. People on mixed diet have slightly higher blood pressure than those on a purely vegetarian dietary.

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## STERILIZATION OF SNAKE VENOM PREPARATIONS

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**Introduction.**—Snake venom is a secretion from the specialized glands in the mouth of the snake, analogous to the salivary glands of other animals. The venom itself is a complicated protein and behaves like an enzyme. It is a neurotropic poison which is also endowed with digestive functions. Its strong proteolytic properties are well known. A rat after being swallowed whole by a snake is completely digested in the gastro-intestinal tract, the ejected faecal matter being only a small ball of hair and nails.

Recent investigations on venoms have enabled the identification of a number of active constituents, namely, coagulative, hæmolytic and neurotoxic principles. These active principles are now being used in therapeutics for different disease conditions. All these isolated principles are used parenterally and, as such, the sterility of these preparations is both urgent and important. There are certain difficulties to overcome because most of the available methods of sterilization act injuriously on these principles and reduce or destroy their potency.

### *Different methods for the sterilization of venom*

1. **Sterilization by heat.**—Rosenfeld and Lenke (1935) reported that sterilization by heat or ultra-filtration seriously damaged the clotting power of tiger-snake venom. They, therefore, made a solution of the venom in physiological saline and added sodium merthiolate, 0.01 per cent, as a preservative. The preparation was stored in an ice-chest for 2 days and found perfectly sterile during the subsequent tests. They reported that this was quite a satisfactory method for tiger-snake venom used for the treatment of hæmorrhage. Grasset (1936) reported that heating of cobra venom at 75°C., destroyed its hæmorrhagic but preserved the neurotoxic principles. Macht (1936) obtained bacteria-free venom by dissolving dried venom in a sterile normal saline solution, and then sterilizing the ampoules at a temperature not exceeding 60°C. These ampoules, when stored in the refrigerator, retained their sterility and potency for many months.

2. **Sterilization by desiccation.**—Some manufacturers supply concentrated venom in sealed ampoules after drying it in a vacuum

desiccator. The venom so kept is believed to retain its potency indefinitely and it remains bacteria-free. Normal saline is added and fresh solution is prepared from the ampoules at the time of injection. Since the authors did not test the sterility of these preparations, it is not possible to comment on their sterility.

3. **Sterilization by antiseptics.**—Grasset and Zoutendyk (1935) reported that cobra and Russell viper venom, when treated with 1 per cent formalin and kept at 37°C. for 3 weeks, were both sterile and detoxicated. In this condition rabbits could easily stand 100 MLD of cobra venom and 200 MLD of Russell viper venom. Some workers have suggested that 0.5 per cent phenol and 10 per cent glycol (or glycerine) or addition of tricresol were useful preservatives against contamination by non-spore-forming organisms.

4. **Sterilization by filtration.**—Berkefeld Seitz or ultra-filters are known to hold back bacteria and spores. This method, therefore, is often recommended for sterilization when chemical agents cannot be used. The filtration method is generally used for sterilizing sera and antivenene. The same method could be utilized for the sterilization of snake venoms but it is doubtful if the large globulin molecules of snake venom will pass through the filters. Chopra and Roy (1936), while studying the hæmolytic properties of snake venoms, observed that cobra venom solutions, after passing through a Seitz filter, lost their hæmolytic properties. Sheep corpuscles, which are usually resistant to cobra and Russell viper venoms but are markedly hæmolysed in the presence of a trace of lecithin, were found to be unaffected by the filtered venoms in the presence of various concentrations of lecithin. One of the writers (J.S.C.) further observed that the action of the filtered venom on the respiratory centre was considerably diminished but its proteolytic properties remained intact. In our recent experiment on the thrombin content of venoms, it was observed that cobra venom after 2 or 3 filtrations entirely lost its thrombin activity.

### *Method of venom preparation*

For preparing snake venom solutions for therapeutic use Chopra and Chowhan (1937) dried it in a desiccator over calcium chloride or concentrated sulphuric acid, until a constant weight was maintained for 3 successive days. The dried venom was dissolved aseptically in sterile normal saline, shaken for half an hour daily for 3 days and kept in the refrigerator for the rest of the time. When the venom had thoroughly gone into solution more sterile saline was added to it till a concentration of 1/10,000 was obtained. Then 0.25 to 0.5 per cent phenol was added to the solution as a preservative. The solution was standardized and its potency worked out in mouse units (a mouse unit being the maximum amount of venom which does not kill a 20 gm. white mouse in 24 hours). The

solution was stored in a refrigerator for 3 to 6 days and finally tested aerobically and anaerobically. Most of our samples, prepared during the last 4 years by this method, proved perfectly sterile and retained intact all the active principles of the venom.

#### *Defect of the method*

The success of the above method depends largely on the process of collection of the venom. The results previously reported were obtained with venoms supplied by the Haffkine Institute, Bombay, which are collected with proper aseptic precautions. Since the beginning of 1940 venoms were obtained from the local market in Calcutta. Solutions made with these venoms, when tested for sterility by the bacteriological laboratory, were found to be contaminated, more often Russell viper venom solutions but the cobra venom solutions as well.

Dry cobra and Russell viper venoms from these sources were also contaminated. These contaminated venoms regained their sterility on being treated with ether for 3 days, dried and then made into solution. It was thus clear that venoms supplied from the local market were grossly contaminated and could not be sterilized by the method we used.

#### *Quality of venom preparations on the market*

At this time we received reports that various injectable preparations on the market, though supposed to be sterile, were also found to be contaminated. A number of venom products manufactured locally in Calcutta, which were examined, was also contaminated with aerobic organisms and, on plating, gram-positive rods were detected. Pasricha and Abedin (1941) in India and Kellaway and Williams (1933) in Australia tested batches of commercial preparations of snake venoms containing 10 per cent glycerine and sufficient concentration of phenol to kill other than non-sporing organisms. Viable spores were identified and *Bacillus subtilis*, *Vibrio spetique*, and a bacillus resembling *Bacillus cochlearius* were isolated. The probable source of contamination seemed to be in the venom itself.

#### *Suggestions for improvement*

Fairley and Splatt (1929) and Williams, Freeman and Kennedy (1934) reported that the yield of snake venoms is altered in quality, quantity and physical characters after the snakes are kept in captivity for a long time. The bacterial flora of the mouth of Australian venomous snakes, when kept in captivity or after frequent extractions of venoms, were very much increased. *Bacillus proteus* and a small gram-negative coccobacillus were frequently present. Anaerobic non-lactose fermenters, *B. proteus*, *B. pyocyaneus*, *B. alkaligenes faecalis*, coliform bacilli and staphylococci were also occasionally isolated. Drying appeared to kill many of these non-lactose fermenters. The mouth of recently

caught snakes is practically free from bacterial contamination. Snakes kept in healthy, well-drained and open parks and under as natural conditions as possible, also have their buccal cavity relatively sterile. The venom obtained from these snakes, and thoroughly dried, can be considered practically sterile, and solutions made out of it aseptically with tricresol or phenol in 0.25 to 0.5 per cent as preservatives would generally be sterile.

#### *Experimental*

The following methods used for sterilization of venoms were tested:—

1. *Heat method*: The venom consists of neurotoxin, hæmolysin and esterase. Of these the neurotoxin is stable up to 70°C., hæmolysin is reduced at 100°C. (15 minutes' contact) and esterase activity is destroyed at 56°C. in half an hour. Prolonged heating of cobra venom converts it into lysocytin with marked fibrolytic properties. It was, therefore, decided to sterilize the venom preparations by the method of *tyndallization* or fractional sterilization. In this process the venom solution was heated at 60°C. for one hour daily for 3 days on a water bath and kept in a refrigerator for the rest of the period. It was then tested for sterility and strength. This process allowed spores to develop vegetative forms which were subsequently destroyed by the above temperature.

2. *Chemical antiseptic method*: Phenol in 0.25 to 0.5 per cent concentration, tricresol (cresol B. P. cresylic acid) in 0.25 to 0.5 per cent or sodium merthiolate in 0.01 per cent concentration has been recommended as suitable antiseptics for venom solutions. These antiseptics were at first diluted in normal saline solution and then added drop by drop to the whole bulk. The preparation was kept in a refrigerator for 3 days and then tested for toxicity and sterility.

3. *Filtration method*: Seitz, Berkefeld and Sinter glass filters were utilized for this study and filtrates collected into sterile receptacles. To obviate the difficulty arising out of the adsorption of large protein molecules responsible for the coagulating effect of the venom, the following corrections of the method were made:—

Reduction of the size of the filter disc.

Rejection of the first 16 to 20 c.cm. of the filtrate.

Use of fused glass-wool filters to avoid adsorption through the pores.

#### *Experimental details*

By following the foregoing methods both cobra and Russell viper venoms were studied from the standpoint of toxicity and sterility. This latter part of the work was done under the

direction of Major C. L. Pasricha, I.M.S., in the Department of Bacteriology and Pathology. The toxicity tests were conducted in our own laboratory.

Cobra and Russell viper venoms were diluted to 1 in 10,000 and 1 in 2,000 respectively in sterilized normal saline solutions and their relative toxicities studied before and after sterilization by the methods mentioned above. Injections were made deeply into the pectoral muscles in the case of cobra venom solution and the death rate after 24 hours recorded. Russell viper venom was injected into the left wing vein of the animal and the number of deaths occurring within 15 minutes were counted. The MLD for each batch of solution was worked out from this. Tables I, II and III represent these results.

TABLE I

*Effect of different methods of sterilization on the toxicity of cobra venom (dilution 1 in 10,000)*

|                  | METHODS OF STERILIZATION |                    |                |           |
|------------------|--------------------------|--------------------|----------------|-----------|
|                  | Phenol                   | Sodium merthiolate | Tyndallization | Control   |
|                  | 0.1-0.2                  | 0.1-0.2            | 0.1-0.2        | 0.1-0.2   |
| MLD pigeons, mg. | 0.1-0.2                  | 0.1-0.2            | 0.1-0.2        | 0.1-0.2   |
| Death interval.  | 1½ hours                 | 3 hours            | 1½ hours       | 1-2 hours |

TABLE II

*Effect of different methods of sterilization on the toxicity of Russell viper venom (dilution 1 in 2,000)*

|                  |    |    | METHODS OF STERILIZATION |                    |                 |              |             |              |
|------------------|----|----|--------------------------|--------------------|-----------------|--------------|-------------|--------------|
|                  |    |    | Phenol                   | Sodium merthiolate | Tyndall-ization | Filtration   |             | Control      |
|                  |    |    |                          |                    |                 | Once         | Twice       |              |
| MLD pigeons, mg. | .. | .. | 0.005-0.008              | 0.02-0.03          | 0.008-0.01      | 0.025-0.03   | 0.15-0.3    | 0.005?-0.008 |
| Death interval   | .. | .. | 5-15 minutes             | 4-24 hours         | 3-4 minutes     | 5-10 minutes | 24-74 hours | 5-15 minutes |

It is evident from table II that, as in the case of cobra venom, methods of sterilization by phenol and tyndallization do not materially modify the toxicity of Russell viper venom. This is, however, not the case with sodium merthiolate which considerably reduces the toxicity of this venom. So far as the filtration method is concerned (Seitz filter by suction) it very much reduces the toxicity of venom. The first filtration reduces it to one-third and the second filtration to one-tenth of its strength.

TABLE III

*Effect of different methods of sterilization on the sterility of cobra and Russell viper venoms (dilutions 1 in 10,000 and 1 in 2,000 respectively)*

| Methods of sterilization     |                       | ORGANISMS      |           |              |           |
|------------------------------|-----------------------|----------------|-----------|--------------|-----------|
|                              |                       | 24 hours later |           | 7 days later |           |
|                              |                       | Ærobie         | Anæ-robic | Ærobie       | Anæ-robic |
| Cobra venom<br>1 in 10,000.  | Phenol ..             | 0              | 0         | 0            | 0         |
|                              | Sodium merthiolate .. | 0              | GF        | 0            | 0         |
|                              | Tyndallization        | 0              | 0         | 0            | 0         |
| Russell venom<br>1 in 2,000. | Phenol ..             | 0              | 0         | 0            | 0         |
|                              | Sodium merthiolate .. | 0              | 0         | 0            | 0         |
|                              | Tyndallization        | +              | +         | +            | +         |

GF = gas formers; + = present; 0 = absent.

It appears that both tyndallization and phenol 0.5 per cent proved effective in rendering the cobra venom solution sterile. Sodium merthiolate 0.01 per cent rendered it sterile ærobie, but did not kill the anærobic organisms in 24 hours. They were, however, absent after 7 days. As for Russell viper venom both phenol and sodium merthiolate rendered the solution perfectly sterile; tyndallization, however, had no effect on ærobie and anærobic organisms.

### Summary and discussion

We have already seen that of the four methods of sterilization tyndallization was found to be the most unsatisfactory for Russell viper venom. This was possibly due to the fact that this venom is contaminated even in the dry form. The process of filtration appeared to be satisfactory from the point of view of sterility but it markedly altered the toxicity of the venom.

(Concluded on next page)

## A NOTE ON EUCODAL HABIT IN INDIA

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## Introduction

EUCODAL is a synthetic German product belonging to the morphine series and is used for its analgesic effect. After the Great War of

(Continued from previous page)

The filtration method is effective but it reduces the therapeutic efficiency of the preparation. Sterilization by sodium merthiolate, phenol or tricresol is the more suitable method and keeps all the active principles of venom intact. Particular care has, however, to be taken with regard to the collection of the material and the preparation of venom solution. If this is not done, serious consequences may follow from the use of contaminated venom solutions.

## Conclusions

(1) Snake venom preparations are often contaminated, hence their sterilization is indispensable.

(2) Venom milked from snakes kept in captivity and from badly handled snakes is usually contaminated.

(3) Filtration, though recommended as the best method for sterilization, has been found to hold back some of the active principles of venom.

(4) Preparation of venom solution from properly collected venom with all aseptic precautions, and by the addition of phenol or sodium merthiolate as preservative, is very satisfactory and keeps the venom solution bacteria-free.

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1914-18, a number of cases of addiction to this drug came to our notice in India. Some of these came for treatment on account of the difficulty in obtaining the drug. Others were detected in a peculiar manner. One of the authors found a person buying empty packing boxes of eucodal from a firm of chemists in Calcutta. On inquiry it was found that these boxes were filled with ampoules of other narcotic drugs such as morphine and sold as eucodal at exorbitant prices. It was also learnt that some well-to-do people were in the habit of using this drug for its euphoric and supposed aphrodisiac properties. The 'Controller of Prices' in Calcutta has recently prosecuted a firm of pharmaceutical chemists under the Defence of India Rules for selling a box of eucodal ampoules for Rs. 50. These instances show that the drug is being used in this country by a section of the population who are in a position to pay high prices for it.

*Chemical nature and medicinal properties.*—Eucodal (dihydroxycodine) is a derivative of the opium alkaloid, thebaine, and resembles dicodide (dihydrocodeinone) in some respects. Pharmacologically it is more active than dicodide, its activity approaching that of morphine. Eucodal is a powerful analgesic and narcotic. Its narcotic effects are stronger than those of morphine but are shorter in duration—4 to 6 hours instead of 8 to 12 hours. In small doses, it has a soothing action on the central nervous system resulting in hypnosis and slowing of the pulse and respiration. Relief of bodily fatigue and a sense of security are also observed. In larger doses, vertigo, agitation, myosis and even convulsions are produced. It is a cardiac depressant and may reduce blood pressure considerably. The bowels are not constipated by eucodal.

*Place of eucodal as a substitute for opium alkaloids.*—A comparative study of eucodal, morphine, heroine, codeine and dionine demonstrates that this group of opium derivatives has certain resemblances and contrasts: amongst them the action of morphine and eucodal are the most alike, the initial stage of agitation being absent in eucodal though the narcotic and analgesic effects are stronger. With regard to their analgesic effect, in the decreasing order of potency the opium derivatives hold the following position: eucodal, morphine, heroine, codeine and dionine. So far as production of euphoric effects is concerned, morphine and heroine are superior to eucodal but codeine and dionine are inferior to it. As a cough reliever, eucodal is less efficacious than codeine and morphine; as respiratory depressant, which is also an index of toxicity for this group of drugs, heroine holds the topmost place, eucodal, morphine, codeine and dionine coming in order of their potency.

*Eucodal habit.*—It was generally believed that this drug was not liable to produce habit formation in the same way as morphine. It has, however, been found that this belief is not justified. There is practically no difference between morphine and eucodal in this respect and its sale should be submitted to the same restrictions. The withdrawal symptoms are also practically the same and cardiac weakness, irritability, suicidal tendencies, loss of appetite, diarrhoea, and craving for the drug are present. After complete withdrawal some amount of self-centredness persists. Itching of the skin with urticarial rashes was observed in one of our cases. When the drug was given to relieve pains of dysmenorrhoea in young girls suffering



from anæmia, it caused a sense of mental apprehension, exhaustion, giddiness, sweating and a desire to sleep.

**Doses.**—The doses taken by individuals in our series were generally within the therapeutic limits, i.e., 0.03 gm. ( $\frac{1}{2}$  grain) once or twice a day. But when it was taken parenterally, 1 c.cm. or 2 c.cm. ampoules containing 0.01 to 0.02 gm. ( $\frac{1}{6}$  to  $\frac{1}{3}$  grain) of the alkaloid were used. According to Falk (1919), 0.02 gm. is a more suitable dose for its analgesic effect than 0.01 gm. It seems that 0.005 gm. of eucodal corresponds in its effects to 0.01 gm. of morphine or 0.03 gm. of codeine.

#### Discussion

According to Wolff (1928), cases of addiction to this drug originally came into being during the last Great War. Koenig (1919) first described a case of eucodalism and reported symptoms similar to those of morphinism. Amongst the cases that have come under our observation in India, there were two individuals who exhibited a craving for the drug and feeling of malaise when the drug was not forthcoming. Both these patients had been taking the drug for more than two weeks. Falk (1927) and Baumm (1919) could find no marked abstinence symptoms. We have, however, observed abstinence symptoms in our cases, very similar to those found with morphine and it is often difficult to differentiate one from the other. The ideas flow very rapidly and there is difficulty in concentration. Neurotic symptoms are more common with eucodal in its fully developed stage than in the case of morphine. During the withdrawal period the addict fails to appreciate his position, there is a feeling of apprehension, impending death and suffocation, and pseudo-anginal attacks may also occur. Lemperg (1936) observed a doctor aged 33 who took 9.0 gm. of eucodal per day. He was irritable and even dangerous for his patients. He became ataxic during the withdrawal period and died on the thirteenth day of the course of treatment. In Indian addicts the withdrawal was effected without much difficulty.

**Conclusion.**—Though eucodal has certain advantages over morphine, the possibility of contracting a habit from it is not less serious than from morphine or heroine. Fortunately the drug is not available at present owing to war conditions.

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## PASTEURELLA PSEUDOTUBERCULOSIS 'SWARMING COLONIES'

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DURING experiments designed to demonstrate the motility of *Pasteurella pseudotuberculosis* macroscopically it was noted that when this organism is inoculated on the surface of nutrient agar (0.5 to 1 per cent) and incubated at room temperature (70° to 80°F.) it grows in the form of spreading colonies similar to the 'swarming' *Proteus* colonies. When incubated at 37°C., the growth is limited to the area of the inoculum. At room temperature the growth continues to spread for three days. If a plate that has been incubated at room temperature and shows a spreading form of growth is subsequently incubated at 37°C., the further 'swarming' of the colony stops. A colony grown at 37°C., and restricted mainly to the area of inoculation, when incubated at room temperature, spreads over the surface of the medium. Smears made from the margin of a swarming colony show actively motile bacilli, but smears from the centre of the colony show mainly non-motile forms. Smears from the growth incubated at 37°C. show no motility. When stained for flagella by the Plimmer and Paine (1921) method, the growth from the edge of the colony incubated at room temperature shows the majority of the organisms with two polar flagella, whereas the growth from the centre of such a colony or from a growth at 37°C. shows no flagella.

The growth incubated at 37°C. is more opaque than the growth at room temperature.

The spreading of *Past. pseudotuberculosis* is well seen in stab cultures in semi-solid agar incubated at room temperature, whereas it is absent in similar cultures incubated at 37°C. Another point of interest noted in growth on  $\frac{1}{2}$  to 1 per cent agar incubated at room temperature is that certain of the strains are contaminated with bacteriophage (a number of bacteriophage colonies develop in the growth), whereas in the restricted growth at incubator temperature bacteriophage colonies are not seen.

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(Continued from previous column)

\* It was not possible to put these in the usual form, as they could not be consulted in the original. They are therefore, put in the form in which they appear in the 'Technical Study of the Comparative Effects of Morphine and of certain Habit-forming Drugs: Eucodal, Dicodeide, Dilauidide, Acedicone', *Bulletin of Health Organization, League of Nations* (1939), **8**, 387.—EDITOR, I. M. G.



# OBSERVATIONS ON SOME IMMUNOLOGICAL ASPECTS OF *LEPTOSPIRA ICTEROHÆMORRHAGIÆ*

## PART III

### DEVELOPMENT OF ACTIVE IMMUNITY IN MAN FOLLOWING THE INJECTION OF *LEPTOSPIRA* VACCINE

By B. M. DAS GUPTA

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Active immunization against leptospiral infection was first demonstrated by Ido *et al.* (1916). They successfully immunized guinea-pigs with killed leptospira in the liver emulsions of infected guinea-pigs. Noguchi (1918) employed leptospira cultures instead of infected liver emulsion, and found that the inoculation of the killed cultures in sufficient quantities afforded complete protection to the same animals against a subsequent infection with virulent cultures of both homologous and heterologous strains. On account of the encouraging results obtained with guinea-pigs, miners in Japan have been inoculated with killed cultures and satisfactory protection results claimed. For example, Wani (1933) inoculated several miners and noted that in one mine and during the same period five cases occurred among 3,655 vaccinated and 70 among 6,266 non-vaccinated miners.

As recorded by Walch-Sorgdrager (1939), 20 persons were inoculated in Amsterdam and 18 of them showed titres of at least 1 in 100; the other two (one of which had received only one injection) did not develop any demonstrable titre.

Uhlenhuth and Zimmermann (1934) immunized three of their staff with 2 doses of vaccine injected at an interval of a week. Two weeks after the second injection the sera in one of them reacted to titres of 1 in 100 and in the other to 1 in 50, but neither protected guinea-pigs against a virulent culture.

Van Thiel (Walch-Sorgdrager, 1939), on the other hand, has noted that even when the serum showed a low titre, it protected guinea-pigs against virulent cultures.

Smith (1937) inoculated 122 persons with killed virulent and non-virulent cultures of *L. icterohæmorrhagiæ*. The blood samples of only 48 persons were available later for testing the serum reaction. In one it reacted to a titre of 1 in 10 only and in 11 to a titre of 1 in 30. All the remaining persons showed no evidence of the production of demonstrable immune bodies. It appears from the above brief review that the results obtained by different workers are not in agreement. In the hope of clearing up the apparent discrepancies we undertook the following investigation and for this purpose we utilized some members on our staff and some kala-azar

convalescents who had completed their courses of treatment.

### Materials and methods

A strain of classical *L. icterohæmorrhagiæ*, which was isolated locally from a severe case of hæmorrhagic jaundice, was used. The virulence of the strain was maintained by frequent passages through young guinea-pigs. The spirochæte was cultivated in the medium advocated by the Dutch workers in Amsterdam\*. The cultures were incubated for 24 hours at 37°C. and then kept at laboratory temperature (22°C. to 30°C.) for about a week. The contents of several tubes were pooled and centrifuged for an hour at the rate of 8,000 revolutions per minute. (It is important to note that it is useless to centrifuge at low speed, because the leptospiræ do not come down except at high speeds.) After centrifugalization most of the upper portion of the fluid, which is practically free from the spirochætes, was removed as quickly as possible. The remaining portion, showing a high concentration of the organism, was phenolized so that the culture contained 0.5 per cent phenol and it was used as a vaccine. But it was soon noticed that after treatment with phenol the organisms were disintegrated, rendering their enumeration impossible. Formalin (0.3 per cent) which well preserves the integrity of the spirochætes was, therefore, substituted.

As the growth of the leptospira does not produce any appreciable turbidity in this medium standardization of the vaccine by comparison with opacity tubes (Brown's method) was not applicable and Wright's laborious method of enumeration of micro-organisms against red blood corpuscles had to be resorted to. Even this method did not yield satisfactory results; for the spirochætes often formed large clumps, thus rendering the counts difficult and the distribution uneven. Each cubic centimetre of the vaccine contained approximately 100 million spirochætes. Before inoculation each brew was tested for sterility by cultural examination and guinea-pig inoculation. The method employed in vaccination consisted in giving of 1 c.cm. (100 million organisms) subcutaneously, followed by another dose of double quantity at an interval of a week. From 10 to 12 days after the second inoculation a specimen of blood was

\* The preparation of the medium is as follows:—

Tap water, 1,500 c.cm.

Peptone (Witte), 1.5 gm.

Add normal phosphoric acid until pH = 7.

Boil.

Add 300 c.cm. of Ringer's solution and 150 c.cm. of Sørensen buffer mixture (pH 7.2).

Boil until precipitation is complete.

Filter.

Check pH and readjust, if necessary.

Place 5 c.cm. in each long narrow tube.

Autoclave.

Add 0.5 c.cm. of fresh sterile inactivated rabbit's serum.

Test sterility.

obtained and tested for the presence of agglutinating and protective antibodies.

### Results

Eight members on the staff were vaccinated as detailed above; the serum of one reacted to a titre of 1 in 1,000, four to a titre of 1 in 300 and two to a titre of 1 in 100. These sera also afforded effective protection to guinea-pigs, while all the control animals receiving normal human serum before infective inoculation, succumbed to leptospiral infection. The serum of the remaining person showed neither any demonstrable agglutinating titre nor protective action on the guinea-pig. After 11 months these seven men were examined again for evidence of the persistence of immune bodies and it was found that the agglutinating titre had fallen to 1 in 20 in one case and to 1 in 10 in another, and the remaining persons showed no demonstrable serological titre.

It is interesting to note that the serum of the person showing a drop in the agglutinating titre from 1 in 1,000 to 1 in 20 was still protective against a fatal dose of a virulent culture in a guinea-pig.

In the second series of 12 persons convalescent from kala-azar, the serum of two had a titre of 1 in 200 and in another it was only 1 in 80. These three sera contained sufficient antibodies to protect guinea-pigs against a virulent culture. All the rest gave no immunizing response whatever to the vaccination, although the same brews of the vaccine were used for the second series.

### Conclusions

(1) Nearly all healthy individuals can be successfully immunized against *L. icterohæmorrhagiæ* by vaccination.

(2) The serum of people thus immunized, even when showing a low agglutinating titre, is capable of protecting the guinea-pig against virulent culture (homologous strain).

(3) In the blood of the vaccinated persons immune bodies (agglutinins and protective antibodies) do not seem to persist longer than 11 months.

(4) It seems that kala-azar convalescents are unsuitable for testing the effectiveness of leptospira vaccine.

Our thanks are due to Dr. L. E. Napier, for allowing us to perform the experiment on some of his kala-azar patients, and to Dr. A. K. Hazra, of Messrs. Bengal Chemical & Pharmaceutical Works, Calcutta, who helped us in many ways in connection with this investigation, especially in the matter of having the leptospira emulsions centrifuged with a high-speed machine belonging to his firm. Also to Mr. R. L. Sen, B.Sc., for his valuable help.

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## A Mirror of Hospital Practice

### A HYDATID CYST OF THE SPLEEN

By L. M. CHOUDHURY, B.Sc., M.B., B.S.

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and

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S. L., male, aged 45, was admitted into the Patna Medical College Hospital on 19th August, 1941, with the complaint of a lump in the abdomen for a year...

**Examination.**—Patient was of average build. Temperature normal, pulse 80, respiration 24, blood pressure 130/85. There was a lump in the left hypogastrium, globular in shape, extending from the left costal margin down to the umbilicus and from the left flank to the middle line. It was found to be incorporated with the spleen and was cystic in nature. There was no hydatid thrill. No abnormality could be detected in any other system.

**Investigations.**—Blood: Total erythrocytes—3,840,000; total leucocytes—8,800; polymorphonuclears—68 per cent; large mononuclears—2.5; lymphocytes—20.5; eosinophiles—8.0; basophiles—1.0.

No abnormal cells seen. Serum aldehyde and serum antimony tests—negative.

Wassermann reaction—negative.

Stool—nothing abnormal.

Casoni's intradermal test—doubtful.

Diagnostic puncture was done—fluid slightly turbid. There was a trace of albumin, a heavy amount of chloride, a trace of urea, and Benedict's solution was reduced. On microscopic examination—numerous erythrocytes and a large number of the scolices of *Tania echinococcus* were found.

The patient was operated upon and splenectomy was done.

### Comments

1. Hydatid disease is rare in India. Hydatid cyst of the spleen is very rare even in places where the disease is common.

2. Clinically it could not be diagnosed as hydatid cyst of the spleen. Eight per cent eosinophilia could not be taken into account as it has no importance in the tropics. Further, Casoni's test, which is said to be positive in 90 per cent of cases, was doubtful.

4. Exploratory puncture had to be done because of the uncertainty of the diagnosis.

5. In the pathogenesis of hydatid disease the embryos are carried in the portal vein to the liver and through the liver to any other part of

the body and produce cysts. It was peculiar in the present case that no other site showed hydatid cysts. As it has to pass the filter of the liver one would naturally expect it to be affected as well, but in this case it was free.

### Acknowledgments

Our thanks are due to Captain R. P. Ghosh, superintendent, Patna Medical College Hospital; Dr. T. N. Banerji, professor of medicine; Dr. S. M. Ghosal, lecturer in children's disease and medical registrar; and Captain N. Pal, M.B., F.R.C.S.E., professor of surgery, P. W. Medical College, Patna, for permission to report the case.

## A CASE OF ACUTE HÆMORRHAGIC PANCREATITIS

By A. G. PEREIRA, L.M. & S.

District Medical Officer, Coimbatore

K. I., male, aged 45, was admitted into the Government Headquarters Hospital, Coimbatore, on 30th June, 1941, with a history of sudden intense pain in the abdomen which started just above the umbilicus, shooting through to the back and loins. The pain started at about 8 a.m. after breakfast on 29th June. It steadily increased. He vomited bile-stained fluid 3 or 4 times. Signs of collapse were present; bowels moved once.

No history of similar attack before; no history of gastric or duodenal ulcer; no biliary colic; non-alcoholic; no history of any acute infectious fevers; complained of occasional 'indigestion'; no history of trauma.

The patient was thin and pale. He appeared very ill, rolling in bed with excruciating pain in the abdomen. Breathing was rapid, he had an anxious look, there was no cyanosis and his tongue was dry.

Abdomen was much distended and rigid; tenderness all over the abdomen, more marked in the epigastric region and right iliac fossa; shifting dullness present; pulse rapid; heart and lungs normal. Temperature 101°F.; pulse 98; blood pressure 140/100; urine normal. The pain was coming on frequently and he had to be given injections of morphia.

On 2nd July under spinal anaesthesia the abdomen was opened by a right paramedian incision. Blood-stained fluid escaped out of the abdominal cavity and the cavity was mopped dry. Stomach and duodenum were examined for any perforation. Generalized peritonitis was present. There was a generalized inflammation of all the structures and inflammation of the whole pancreas was obvious. The head, body and tail of the pancreas were very much swollen and hard, and there were numerous hæmorrhagic spots all over its surface. There was no fat necrosis. The abdomen was closed, with a drainage tube in the right flank and another in the epigastric region reaching up to the head of the pancreas.

He was given sulphonamide injections once a day for four days. Sulphonamide tablets 2 *i.d.s.* for four days and symptomatic treatment adopted.

By the 5th or 6th day the temperature touched normal. The patient felt better day by day. Blood-stained fluid drained out through the drainage tubes. The tenderness in the abdomen gradually subsided. The distension and the pain lessened. The drainage tube

in the flank was shortened gradually and by the 12th day the wound closed. The epigastric drainage tube was discharging blood-stained fluid till about the 30th day and then the wound gradually healed. No fat necrosis was noted.

Discharged well on 12th August.

## TREATMENT OF SMALLPOX WITH AN ANTIGEN-ANTIBODY MIXTURE

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VACCINIA virus has long been used as a prophylactic against smallpox but it has not been used as a cure in this disease. A mixture of vaccinia virus and serum from convalescent smallpox cases was tried in a small number of smallpox cases at the Campbell Hospital, Calcutta, early this year when the epidemic was at its peak.

Five cases of the severest confluent type were selected for our experiment. The results were encouraging. An example of one case is given below.

The patient, S. A., aged 17, confluent type of variola (*vide* plate I, figure 1); treatment started on the 7th day after the first appearance of the eruptions.

| Date       | Subcutaneous injections                                      | Temperature, °F. |
|------------|--|------------------|
| 18th April | 8 c.cm. serum + 2 c.c. vaccine lymph.                        | 104.0            |
| 19th April | 18 c.cm. of diluted (1 in 10) serum + 2 c.cm. vaccine lymph. | 103.0            |
| 20th April | Same as on 19th April  | 98.5             |
| 21st April | Ditto  | 98.5             |
| 22nd April | Ditto  | 98.5             |

### Comment

Recovery was much earlier than could otherwise be expected. Serum alone did not bring down the temperature earlier in some other cases. Patel and Naidu (1940) reported that convalescent serum as well as calf and sheep sera did not significantly reduce the mortality of smallpox cases. The number of cases is so small that a definite conclusion cannot be arrived at. The epidemic subsided before we had collected sufficient convalescent serum and tested all samples for sterility and for the Wassermann reaction, but the results are so encouraging that we hope to continue the work during the next epidemic season.

The rationale of the treatment is the same as in sero-vaccine treatment. Antitoxic and antiviricidal principles present in convalescent variola serum partly neutralize the virus and its toxins that overpower the reticulo-endothelial system of the body. The system thus released is free to act and develop immunity in response to the foreign antigen injected.

Our thanks are due to the superintendent and Dr. B. C. Chatterjee, the officer in charge of the smallpox ward of the Campbell Hospital, for giving us free scope for conducting our experiments.

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### A VERY LARGE OVARIAN TUMOUR

By RAI BAHADUR CHHAGAN NATH

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A FEMALE, aged 30 years, was admitted to the Lansdowne Hospital, Udaipur, on the 29th April, 1941, with an abnormally huge abdomen supported on thin and emaciated legs with a typical side-ways gait.



Fig. 1.—Before operation.

**History.**—The patient was a nullipara with regular menstrual history except for the last year. Three years back she noticed a small swelling in the right iliac region which appeared to be increasing slowly in size till it reached the present dimensions.

**Family history.**—Nothing special.

**Physical examination.**—Patient lying on the back was unable to see the lower extremities. Abdominal veins prominent. Fluid thrill present. Abdominal viscera were not palpable owing to marked distension of the abdomen. Heart—displaced upwards with feeble sounds. Costal angle—markedly obtuse. Vaginal walls—protruding, owing to pressure from above.

**Dimension of the abdomen before operation.**—Circumference at the umbilicus—52 inches. Maximum circumference—58 inches. Distance between ensiform cartilage and symphysis pubis—29 inches. Distance between anterior superior iliac spine and umbilicus on the right side 15 inches, and on the left side 18 inches.

The patient was operated upon on 31st May, 1941, and 25 pounds of fluid and 18 pounds of solid tumour

(total 43 pounds) was removed. The patient made an uneventful recovery.



Fig. 2.—After operation.

The interesting feature in the case is that a tumour of such a large size and weight is a rarity.

My thanks are due to Dr. M. H. Hakim and Dr. G. Rudraniamma for help in operating.

### A CASE OF RUPTURE OF UTERUS DUE TO HYDROCEPHALUS

By A. CHACKO, W.M.S.

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A FEMALE, aged 28 years, was admitted into hospital on 15th March, 1941, at 9 p.m. She gave a history of having been in labour for 4 days in a village 10 miles away.

**Examination.**—General build was good, but she was extremely exhausted and her temperature was 100.4°F. Pulse 120 per minute. Abdominal examination showed classical signs of obstructed labour with a very big head at the lower part of uterus. Foetal heart sounds very faintly heard. Vaginal examination confirmed the diagnosis of hydrocephalus with a brow presentation. Os was fully dilated and there were signs of infection already. There was no vaginal bleeding.

**Treatment.**—The head was perforated and the foetus was extracted without any difficulty. Bleeding started per vaginam and a tear was felt in the left lateral wall of the uterus 3 inches above the cervix, which was intact. The placenta was on the posterior wall and it was manually removed. No intestines were felt through the uterine tear. As the tear was too high for easy packing it was decided to open the abdomen. A tear one and half inches long was found anterior to the left broad ligament. The peritoneum was intact over the tear and there was blood subperitoneally. There was also a big swelling underneath the left broad ligament, which was getting bigger. The rent was sutured with catgut and also stitches were put into the broad ligament after applying pressure, and the bleeding was controlled. Sulphanilamide was applied

to the peritoneum locally and the abdomen was closed with drainage. The patient had soluseptasine and proseptasine for 7 days with other treatment. The stitches were removed on the 8th day and the wound had healed by first intention except where the drainage tube was inserted, which drained pus. The wound was dressed with sulphanilamide. The first 4 days the patient was very ill. But she gradually recovered and was discharged on the 30th day.

#### *Points of interest*

1. Classical treatment of packing for incomplete tear would have turned an incomplete tear into a complete one in this case.

2. Abdominal bleeding was more efficiently controlled and the exact extent of damage was estimated. The drainage per abdomen and per vaginam made the puerperium less difficult to treat.

3. Local use of sulphanilamide gave very satisfactory results.

### A CASE OF TRAUMATIC APPENDICITIS

By M. V. BHAJEKAR, M.A., M.B., B.Ch., F.R.C.S.

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CASES of appendicular disease of all varieties are common enough, and my only justification in reporting the following case, which came under my care as an emergency, is its peculiar history and the current discussion whether trauma can give rise to acute appendicitis. In an editorial in the *Journal of American Medical Association* on 4th June, 1938, it is said that 'the consensus is not only that it can but that the resulting attack is likely to be one of great destructive type, with a clear clinical picture'. The following case corroborates this view:—

A boy, aged 13 years, was admitted into the Sir J. J. Hospital on 21st March, 1941, at 9-30 p.m., complaining that he had been getting severe abdominal pain since 8 p.m. the previous evening.

*History.*—At 4 p.m. on 20th March while trying to open a door, he fell and was hurt in the right lower part of the abdomen by falling flat on his face on the doorstep. He was quite well till about 7-30 p.m. when he began to feel pain in the abdomen. At first the pain was situated below and to the right of the umbilicus. When he was admitted the pain was generalized all over the abdomen. Since the onset of pain he vomited six times and the bowels had not moved. Also he had not passed urine since the accident. He was catheterized on admission to the hospital but unfortunately the amount of urine was not measured.

There was no history of previous abdominal pain. The child had suffered from roundworms previously and was treated for them. There was no history of appendicitis in the family.

*Examination.*—The patient looked somewhat ill. The tongue was dry and coated and the pulse rapid—140 per minute. The abdomen was distended and resistant, more particularly in the right iliac fossa, where he was hurt. There was no rigidity anywhere, and shifting dullness was not definite. On auscultation, sounds produced by peristaltic movements were audible and the heart sounds could be heard on abdominal auscultation.

*Operation.*—The child was prepared for operation and spinal injection of 1 c.cm. stovaine was given.

On palpating the abdomen after administration of the spinal anæsthetic, a lump could be felt on the right side, lateral to and at the level of the umbilicus.

The abdomen was opened through a right paramedian para-umbilical incision. Immediately on opening the abdomen thick yellow pus welled out of the wound. As much of it as possible was removed. On further examination a piece of omentum, brownish black in colour, was found adherent to the cæcum and terminal part of the ileum. This part of the omentum was ligatured and severed from the main body of the omental mass, and it was then easily detached from its adherence to the cæcum and terminal part of the ileum. Underneath it an almost gangrenous and kinked appendix was discovered. The meso-appendix was ligated and cut. The appendix itself was then ligated as near its base as possible, cut distal to the ligature and the stump buried into the cæcal lumen by means of a purse-string suture. As much of the pus as possible was removed by means of a suction apparatus. Two large-bore drainage tubes were inserted through separate stab incisions, one in the right flank and one in the supra-pubic region. The abdominal incision was then closed in layers, leaving a small rubber drain in the lower angle of the wound down to the rectus sheath.

*Post-operative progress.*—The patient kept getting distension for four days after the operation. This was treated by means of a flatus tube in the rectum, injections of acetylcholine and injections of strychnine, atropine and pituitrin. The superficial drainage was removed at the end of 36 hours and the intra-peritoneal drainage tubes at the end of 96 hours.

Sutures were removed on the 10th day, when part of the wound gaped and discharged pus. A light pack was inserted and six-hourly magnesium sulphate fomentations were applied. The patient was discharged on 5th April with the wound almost healed.

On 15th April the wound was completely healed.

Examination of peritoneal discharge on 28th March showed the presence of gram-positive diplococci, gram-negative bacilli; *B. coli* and *Streptococcus faecalis* in culture.

Histological examination of the appendix showed 'Diffuse acute inflammation of all the coats. Mucous membrane ulcerated at places. The congestion is intense and there is some evidence of gangrene commencing'.

The patient came to report on 14th July and said that he was quite well.

I am indebted to Dr. M. G. Pradhan, for examination of the peritoneal discharge, and to Prof. P. V. Gharpure, for examination of the appendix.

I must thank the superintendent of Sir J. J. Hospital for allowing me to report this case.

### A CASE OF HYMEN IMPERFORATA

By M. N. PALADHI, L.M.F.

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A THINLY-BUILT girl, 20 years of age, was brought to me for the treatment of a 'growth' in her lower abdomen. On enquiring into the history, I found that she had felt some sensation in her lower abdomen every month since her 18th year followed by heaviness, which used to persist, resulting in the gradual formation of a mass in the centre of her lower abdomen. The mass now reached 1½ inches above the symphysis pubis. Her breasts were fairly developed. On palpation the mass was felt to be fluctuating. On vaginal examination the hymen was seen to be thick and tough, forming a complete septum without any aperture. On pressure of the abdominal mass, the hymen bulged out.

*Operation.*—No sooner was the hymen opened by a crucial incision than a gush of thick, tarry blood flowed out. The flow continued till it nearly filled a small bucket and the swelling automatically disappeared. The hymen was then snipped off and a vaginal douche of lysol was given; this was continued for about a week. The girl had her next menstruation as usual and from then on continued a normal life.

# Indian Medical Gazette

JANUARY

## BLOOD PRESSURE IN THE TROPICS

VARIATIONS in blood pressure occur under physiological conditions, and the range even of the normal is wide; further, the pressure may differ in the two arms of the same individual. When one is asked what is the normal blood pressure of a man of thirty, a suitable reply is 'what is the height of a man of thirty'? Blood pressure varies as much as height, and the various arbitrarily-assumed standards give only a very rough indication at the least. As a matter of fact, the word 'normal' as applied to physiological standards has never been clearly and convincingly defined; in this case, the 'normal' blood pressure signifies no more than the most common pressure in healthy persons of a specified age group, or, in statistical terms, the median of the frequency curve of the pressures in such individuals.

Observations in western countries show that in normal men between 20 and 60 years, the average systolic/diastolic pressures show an increase from 120/80 to 140/90 mm. of mercury. A systolic pressure below 110 in an adult male is usually regarded as hypotension. When a person whose systolic pressure is found to be, let us say, 108 mm. of mercury complains of general tiredness and premature fatigue, it is not unusual to assume that his symptoms are associated with this hypotensive state. On the other hand, a physician, in the course of routine investigation, will often encounter a subject with a maximum systolic pressure not higher than 100, who is nevertheless bursting with health and energy. Although he may perhaps be unfit for high flight, there is no reason to alarm him about his low blood pressure. The evidence that hypotension is a disease has never been convincing.

The average blood pressure rises with age, but this does not mean that rising pressure is normal. The systolic pressure is liable to greater variation; there may be a transitory rise due to various causes such as emotion, pain, exercise, etc., but the diastolic pressure is more stable. The so-called 'essential hypertension', apparently due to increased arteriolar tone, the exact primary cause of which is yet undiscovered, very often gives rise to no symptoms. The high pressure is needed to maintain the normal capillary flow against the resistance. It has a marked familial incidence and usually becomes evident after the age of 40. It is not uncommon in women at the time of the menopause, and is not infrequently associated with obesity. Many hypertensives however lead an active life and enjoy fair health, the condition being perhaps accidentally discovered in the course of routine

examination for insurance or some other purpose. On the other hand, there are patients who complain of a variety of symptoms, the combination of which is almost diagnostic of hypertension.

Statistics show that expectation of life shortens as the blood pressure rises above normal. Therefore, a man may usually consider himself fortunate if his blood pressure is found to be lower than his standard.

Authoritative 'normal' standards for people in the tropics have not been worked out, although many recorded observations on the past general experience have led to the accepted view that the systolic, diastolic and to a less degree the pulse pressures are lower than those of Europeans and Americans of corresponding age, weight and height living in their own countries. Thirty-five years ago McCay studied the blood pressure of 500 adult male Bengalis. The instrument used was Riva-Rocci's sphygmomanometer, and the systolic pressure was noted at the disappearance of the pulse in the radial artery, the arm being placed on a level with the heart. All readings were taken with the person in a sitting posture. The pressure varied from 95 to 105 mm. Hg., the average being just under 100, or about 15 to 25 per cent lower than in Europeans in Calcutta. Low pressure has also been recorded in other oriental races, by Musgrave and Sison in the Philippines in 1910 and by Cadbury in China in 1922. A few observers, Siler in 1925 and Roddis and Cooper in 1926, have shown that foreigners living in the tropics tend to develop lower pressure; the latter workers found the blood pressure of 67 naval officers 11.4 mm. Hg. lower than that of a corresponding group of individuals in the U. S. A., and that the pressure gradually rose when these officers returned to their own country.

Thus the fact that blood pressures in normal individuals in tropical countries are maintained at lower levels than in colder climates, is more or less established, but there still seems to be some doubt as to whether race or climate is the more important factor in determining the 'normal' blood pressure.

McCay considered that the climate was not the chief cause, because Europeans living in the hot moist atmosphere of Calcutta did not show the low pressure. As the capacity for muscular work in Europeans is superior, he assumed that musculature was superior in the voluntary as well as the involuntary groups. Other workers who have demonstrated the lowering of blood pressure after temporary residence in the tropics claim that climate has a definite effect on blood pressure; this is reduced in the tropics, because the vasomotor tone is at a lower level than in more invigorating climates. Musgrave and Sison thought that the diminution was due to a lower peripheral resistance, associated with cutaneous vaso-dilatation and increased secretory activity of the sweat glands. Incidentally,



it would be interesting to know whether the blood pressures of inhabitants of the tropical zone undergo any change when they live for some time in the temperate zone.

The influence of the cardiac output, elasticity of arterial walls and viscosity of blood have been eliminated as causes of this lower level of blood pressure in normal subjects, but the factors in its causation are probably manifold. These are climate, race, heredity, height, weight, activity, temperament, and diet. Small stature, light weight, simplicity of life, less 'civilization' with perhaps less nervous strain, and a diet largely vegetable and low in animal protein, are common features among the indigenous population of the tropics, many of whom also observe fasting from time to time. If a more detailed study of blood pressure in relation to diet were made, it is possible that some important data would be obtained.

Hypertensive readings are frequently encountered in England and America, where four meals are usually taken daily and there is a preponderance of animal proteins in the diet. Such a diet is liable to give rise to pressor amines or other metabolites in the system, which act as additional factors in keeping up the blood pressure. In this country, similar readings are apparently not uncommon among

the Indians whose feeding habits are similar to those of Europeans, but hypertension is said to be rare in the hard-working villager, whose means will not allow more than two substantial meals a day, and those mostly of carbohydrates.

We are including in this issue a paper based on the blood pressure readings in 10,000 persons, mostly Indians, living in India. These observations show that the average systolic pressure of Indians is from 4 to 14 mm. Hg. and the average diastolic pressure is from 6 to 10 mm. Hg. lower than that of Americans and Europeans of the corresponding age groups, the difference in both cases being greater in the lower age groups. It was also found that the systolic blood pressures were slightly lower amongst the people of Bengal and Madras than amongst those of northern India; a similar difference between vegetarians and people living on a mixed diet was also noticed, but in neither case was there the same difference in the diastolic pressures.

The large number of observations and the constancy of the difference between the pressures of Indians and Europeans put this particular question beyond any possible doubt. It is a pity that the blood pressure data for Europeans living in India, which must be available, cannot be similarly collected and analysed.

## Special Article

### MINOR DRUG HABITS OF INDIA

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#### PART I

*Historical and general.*—The idea of stimulating or 'whipping up' the physical and mental powers of individuals undergoing especially laborious efforts is not a new one. Even in ancient days it was known that certain substances could give the tired and exhausted individuals added strength. These stimulant substances have been commonly called 'dopes'. The term 'doping' in a wider sense means stimulating the body activity, removing the sense of fatigue, as a temporary measure, after physical and mental performance, by taking certain substances, whether food or drugs, whenever it is considered necessary. Samoyed tribes of Mongolia and Siberia, for example, ate fly agaric (*Amanita muscaria*), a mushroom containing muscarine, to rouse themselves to the required pitch of combativeness. The celebrated Berserkers, an ancient class of wild Norwegian

warriors, are also said to have used certain agents in order to gather the necessary rage or frenzy in a battle. They howled like wolves or growled like bears, bit their shields and foamed at the mouth and were believed to possess enormous strength which rendered them invulnerable. The red Indians used to chew coca leaves when a particularly strenuous or protracted effort was required of them. The administration of stimulants to animals taking part in certain sports became so common that in some countries legislation had to be introduced to forbid their use on the ground of cruelty to these animals. The practice of doping race and hackney carriage horses, although not common, still exists in India. In these days of stress and worry the conditions of life are becoming daily more and more difficult, and hard-worked people are more prone to the practice of 'doping' themselves to increase their physical and mental output. Consequently the number of 'dopes' used has increased considerably during recent years. It may even be said that at the present time these substances play an important part in the economic life of nations. Some of these have assumed considerable importance because to millions of people they have become indispensable necessities of life. These 'dopes' consist of substances which either act as readily assimilable foods or merely as stimulants to the nervous system. In this paper we have not

touched on the moral or ethical aspects of this problem, but have made an attempt to explain the effects of common 'dopes' used in India and the effects they are likely to produce on the health of the individuals who use them. We have considered these as a class of minor drug habit.

*Physiology and modes of action of 'dopes'.*—There are many methods of increasing the efficiency of mental and physical performance, the first and the most common being the use of drugs. Secondly by means of concentrated foods, such as sugars, salts, vitamins, etc., which are utilized by the body, particularly during muscular effort. Thirdly by means of substances which can be used as food accessories. And lastly there are certain physical means that can increase the efficiency for work, for example, massage, baths, sunlight, application of cold to the head, etc.

Certain characteristics distinguish substances belonging to the group of 'dopes' from drugs of addiction. Firstly 'dopes' may or may not be used habitually and in increasing doses as is the case with drugs of addiction. They do not affect the system of the individual in such a way as to produce an intense craving and they do not produce marked abstinence symptoms if the dose is not forthcoming. Secondly 'dopes' may not only be drugs but foods, such as, sugars, eggs, substances that are rich in phosphorus, calcium and vitamins. When employed for this purpose, their action generally extends to the brain and particularly to the cerebral cortex. The effect is largely excitation or stimulation, and even if it is highly concentrated and intense, it is produced without bringing into evidence serious symptoms of fatigue or inhibition of certain body functions as is usual in the case of drug addiction. With 'dopes' the mental functions are maintained at their initial level for a longer period than usual, in spite of the natural tendency to fatigue which is the result of labour continued intensely for some time. The sensory activity of the brain is also augmented by the use of some of these substances and this results in a more vivid perception of mental impressions. The will finds the central nervous system more responsive to its orders even with respect to physical exertion and muscular activity. This, however, is not subjectively felt as a constraint produced by the drug.

Another point which distinguishes the 'dopes' from the drugs of addiction and narcotics is that the consciousness of the individual is not diminished, and physical and mental work may be carried out without impairment. This is not the case with the group of narcotic drugs to which belong the majority of drugs causing addiction and which by repeated use damage the functions of the central nervous system. Another interesting feature with regard to 'dopes' is that in this class are included certain substances which also exercise stimulating or depressant effects on organs other than the central nervous system, e.g., circulatory, respiratory, etc.

#### *Group I. Drugs used as 'dopes'*

Drugs which are used as 'dopes' can be grouped under four headings:—

1. Class 'A' consists of substances which act through the central nervous system. They may be stimulants or sedatives.

2. Class 'B' is composed of those drugs which act through the cardiovascular system and which may further be divided into stimulants and depressants.

3. In class 'C' are included hormone preparations which act through the endocrine system.

4. In class 'D' are included metallic preparations such as arsenic and mercury.

#### *'A' drugs acting through the central nervous system*

*Stimulants.*—The common stimulating drugs used as 'dopes' are alcohol, ether, smelling salts, benzedrine, caffeine and strychnine.

1. *Alcohol.*—The 'intoxicating' effects of alcohol are so important that its other properties, such as its being a source of energy and a ready food, merge into insignificance. Alcohol is very rarely used by labourers and athletes in these days, to increase their output of work. On the other hand it is realized that when taken in large quantities it lowers the standard of work. Alcohol only acts beneficially when it is given in a dilute form, in small doses, and at appropriate times. It acts as a stimulant by removing inhibitions and by lessening the sense of fatigue. In the case of very prolonged exertion, such as occurs in workers in mines, the practice of taking a glass of country beer or a dose of country spirit as a stimulant is quite common. Another very common use of alcohol (in a very dilute form) in the form of a 'dope' is prevalent in the hill tracts of India and amongst the aboriginal tribes. Country beers are taken in certain parts of India and there is evidence of their use as far west as Poona, and as far south as Canara and Mysore. In the mountainous regions of India where economic conditions are poor, and the natural craving for a stimulant is greater on account of climatic conditions, the use of varieties of beers and spirits, offered at prices commensurate with the means of the people, has been in vogue for centuries. Such drinks are generally taken in order to tide over the feeling of exhaustion after a day's hard labour in the fields, in the tea gardens or during the trying winter season. They are used by practically all the male and female workers in the coal-mining districts of Bengal and Bihar, who indulge in such drinks after finishing their monotonous and wearisome work, which involves considerable physical strain. The quantities taken are often moderate, just sufficient to relieve the feeling of fatigue and ensure sound sleep. We have been informed by men working in these areas that their work is so hard, uninteresting and tiresome that it would be impossible for them to get through it every day if they did not take these beverages. In fact, many become so used to them that they are unable to work if they do not get them, and the mere prospect of getting a drink is very often an incentive for work. Besides their action on the central nervous system, many of these alcoholic beverages have considerable food value. During the process of fermentation many indigestible carbohydrates are converted into more readily assimilable sugars. The nutritive value of rice beers, such as *Pachwai*, *Zu*, and others, is undoubtedly substantial and they are rich in vitamins. The Nagas, who have fine physique, never drink milk or use it as food; they always drink *Zu* prepared in their own homes.



*Medicated wines.*—During recent years the use of certain medicated wines and proprietary preparations which do not disclose the fact that they contain alcohol has increased in this country. Many people delude themselves with the idea that when a wine is medicated it is free from the harmful effects of alcohol. The common preparations used in this country are Vibrona, Hall's wine, Vermouth, Drakshamalt, Vinomalt, etc. Instances of their habitual use are known among the female members of respectable families who take such preparations, quite ignorant of the fact that it is the alcohol which gives them the sense of euphoria and well-being.

*Discussion.*—To understand the use of alcohol as a 'dope', it is necessary briefly to review the results of experiments carried out by various workers in order to determine the effects of alcohol on the performance of different kinds of work. Hellstien using an ergometer of the Johansson type showed that the administration of 80 grammes of alcohol half an hour before the work was started diminished the total output. On the other hand, small doses of alcohol taken five or ten minutes before the beginning of the work increased the output during the first part of the test but reduced it in the later stages. Other workers have found that a certain dose of alcohol in higher concentrations reduces the quantity of work much more than when it is given in a diluted form. The time of administration is also important. Atzler and Meter have carried out interesting experiments in this connection. They determined the effect of large doses of alcohol (240 c.cm. in beer or brandy) on muscular work in a habitual drunkard. The work was continued to the point of exhaustion on the cycle ergometer. It was found that both the intensity and the total output of work were reduced if alcohol was given on the evening before the test. But if it was taken a few hours before and the work was hard, the aggregate output was slightly increased. When given just before the test, the zeal for the work was enhanced although it was irregular. These authors believe that the immediate effect of alcohol is the production of a feeling of euphoria and happy mood. Our own experience after studying a large series of cases is that alcohol certainly reduces the output of muscular work, especially when it is of a delicate and skilful nature and requires fine co-ordination. If the work is rough, small quantities generally enhance the output. With large doses and with higher concentrations the effects are always detrimental. With small doses and in a dilute form it may produce no appreciable results.

With moderate doses the inhibitory effects of alcohol on the sense of fatigue and the exhausted nerves may often help the individual to perform more work. In physical exertion where only rough muscular effort is required, small doses of alcohol in a dilute form may, to a certain extent, increase the total output of work. But where a finer quality of work is required even small doses may be harmful.

From what has been said above, it transpires that the practice of total prohibition may not be altogether beneficial, as alcohol in small doses, in those who have to undergo hard work and physical strain, causes a feeling of well-being and inclination for work. It has, however, toxic properties, and its use in connection with prolonged muscular and mental work should not be encouraged.

2. *Ether.*—Ether is not used in this country for euphoric purposes and as a 'dope', although instances of such use have been recorded in the west. It is usually taken in the form of 'Hoffmann's drops' which consists of one part of ether and three parts of alcohol. During the last war it is alleged that it was sometimes drunk

by Germans before an attack to produce exhilaration and disregard of danger.

3. *Smelling salts.*—Smelling salts are particularly used by clerks and persons who are engaged in sedentary occupations. The practice is prevalent in large towns of the Bengal, Bombay and Madras Presidencies. The mixture used in this country consists of a solution of ammonia or ammonium carbonate combined in most cases with ethereal oils. The smelling salts reflexly affect the central nervous system by exciting the nasal mucous membrane and in this way produce general stimulant effects. The use of smelling salts is not likely to do any severe harm but when indulged in to excess the practice is likely to produce rhinitis and sometimes sinusitis and headache. It has been observed that prolonged use of these salts leads to a craving for their use.

4. *Snuffs.*—Dried powdered tobacco leaf was first used for stuffing into the nose in Portugal in the middle of the sixteenth century and its use spread to France in the reign of Catherine de Medici. It was believed to be a remedy for colds and headache and was also employed against diseases, real or imaginary, and as an excitant for the nerves. The habit of taking snuff rapidly spread in Europe and from there to other parts of the world. Snuff has been extensively used in Africa where it is frequently mixed with alkaline charcoal or an alkaline sodium salt which probably helps in liberating the alkaloid nicotine. Concentrated extracts of tobacco are also inhaled through the nose. There are many indigenous preparations used in this country for exciting a stimulatory reflex from the nasal mucous membrane. The common ingredients of these snuffs are powdered leaves of tobacco, saffron, powdered chillies, lime, flower of Kaner plant, etc. The snuffs are used by the middle and lower classes.

5. *Cocaine.*—In form of coca leaf this alkaloid is one of the oldest and commonest 'dopes' used in South America, but it was introduced into India about fifty years ago. Elsewhere the present authors (Chopra and Chopra, 1931) have shown that there are between thirty to forty thousand cocaine-eaters in this country. The habit of eating cocaine prevails amongst the artisan class in many of the large towns of India, such as, Calcutta, Karachi, Bombay, Delhi, Allahabad, Benares, and others. The drug is consumed in betel leaf, especially late in the evening. The effect of cocaine is chiefly upon the central nervous system, which constitutes the motive for its use as a stimulant and later, perhaps, as an inhibitory agent. The mental exhilaration or euphoria soon becomes apparent and there is also loss of sense of fatigue. These properties, in conjunction with its anæsthetic action upon the mucous membrane of the stomach, enable the individual to work for prolonged periods without feeling pangs of hunger or sensation of fatigue. Cocaine does not inhibit

the metabolic processes of the body at rest. The habit-forming tendencies of this alkaloid and its other effects have been fully discussed by the present authors elsewhere (Chopra and Chopra, 1931). When the drug is taken during physical or mental exertion, it removes the sensation of fatigue, thus indirectly raising the level of performance in the course of a prolonged effort. This inhibition of the sensation of fatigue, which is the normal safety-valve, is not without its dangers. Even occasional use of this drug might be attended with harmful effects. The people of India appear to suffer more than Indians of South America, and the baneful effects on their health are apparent comparatively earlier and are more potent than with any other drug.

A certain amount of experimental work on the action of cocaine on muscular work has been carried out. It has been shown that the capacity of the subjects for work was much higher after taking 0.1 gm. of cocaine than without it. Large doses gave rise to a feeling of fatigue and disinclination for work. More recent work on metabolism during physical exertion has shown that the output of work is enhanced and the efficiency increased after administration of small doses of this alkaloid. The effects, however, are only temporary. From these experiments it should not be inferred that cocaine is a useful drug for overcoming fatigue and removing depression. It has been shown by the present authors, in Indian subjects, that its use is attended with harmful mental and physical effects, which are more pronounced and set in more rapidly than in the case of any of the other 'dopes'.

6. *Benzedrine (Beta-aminopropylbenzene)*.—Benzedrine sulphate is a harmful stimulating agent which has a distinct effect upon the vegetative nervous system and particularly on the pulse rate and blood pressure. Individuals who do not take this drug habitually may get a rise of blood pressure (both systolic and diastolic) of 10 to 30 mm. of mercury which may persist for several hours. In those habituated to its use these changes are not marked. A few instances of the frequent use of benzedrine have been brought to our notice amongst the members of the medical and allied professions in this country. We know of one instance where the drug was taken regularly by a doctor before going to his consulting-room. Fortunately, its use has not spread amongst the public in general.

The principal beneficial effects are due to its psychic action which is frequently dramatic. Subjectively, there is a change of mood which tends to produce a feeling of euphoria. The individual has a feeling of increased self-confidence, initiative and mental poise; depression is lessened; the processes of thought are accelerated. Immediately after taking the drug there is a sense of increased energy and capacity for work, feeling of exhilaration and a sense of well-being. In some cases there is an increase in the mental activity and general efficiency; there may be a tendency to loquaciousness. This drug has been recommended for diurnal drowsiness and also for certain emotional stresses. Stimulation of the cerebral centres produces insomnia and restlessness. Sargent and Blackburn (1936) have shown an improvement of intelligence by test scores, and Bradley (1937) observed better performance in children with behaviour disorders. Nathanson (1937) tried the drug in patients who

suffered from exhaustion. Beta-aminopropylbenzene sulphate was administered to forty individuals, most of whom did not suffer from any organic disease, and who could be diagnosed as suffering from nervous exhaustion. Focal infection was present in some instances and in other cases the condition followed an infective process. The drug was administered in the form of tablets containing 10 milligrammes, and the majority of them received a daily dose of 20 mgm., one tablet before breakfast and another before the mid-day meal. In patients in whom fatigue was most evident late in the day a single dose of 10 or 20 mgm. was given about 11 o'clock in the morning. The drug was used for periods varying from one week to three months, and with a few exceptions striking physical and mental reactions were observed. There was marked amelioration of symptoms of fatigue, and sluggishness was completely overcome; migraine was also cured in a few cases; sense of increased energy and capacity for work was noticed in more than half the cases; there was also increased mental activity and efficiency.

The effects of prolonged use of this drug so far investigated, are loss of appetite along with increased physical activity, which may lead to a reduction in body-weight. Dryness of the mouth, disturbed sleep, transitory tremors of hands, sweating and palpitation are also sometimes observed. It would thus appear that Beta-aminopropylbenzene (benzedrine) exerts a definite stimulating effect on the higher centres in the central nervous system in most cases. There are, however, considerable variations in the intensity of the response.

In patients who become easily fatigued or who are in a chronic state of exhaustion, this drug has a favourable effect. It should, however, be realized that the effects of benzedrine are purely symptomatic and the drug should only be used when all physical causes of fatigue have been considered and eliminated. It is useful in types of fatigue such as those due to nervous exhaustion, and symptomatic relief in such patients appears to have a decidedly beneficial effect. It is also important to consider in this connection the question of possible harmful effects, including the possibility of habit formation and development of tolerance. The euphoric effects are lessened on continuous administration, but many patients find them sufficiently desirable to continue its use for many months. No instance of true addiction has come to our notice in this country though many authors have given warnings of this possibility.

Many individuals are unable to take benzedrine, as even small doses (5 mg.) produce extreme nervousness, palpitation, vertigo, and excitement which have been described by one patient as 'going crazy'.

7. *Caffeine*.—Although caffeine in the form of tea and coffee is one of the common doping agents used in India, its use in alkaloid form is not seen. The uses of tea and coffee have been discussed in another section.

Caffeine is of value as a stimulant in certain depressed and debilitated individuals. The depression experienced on awakening after the use of hypnotic drugs, over-indulgence in alcoholic drinks or the low spirits of patients with a depressive psychosis are sometimes alleviated on administration of two or three grains of caffeine citrate. Caffeine is also of some use for the prevention of dizziness, disturbances of consciousness, or convulsive attacks of cerebral arteriosclerosis. In clinical experience, caffeine caused little, if any, elevation of blood pressure and is not contra-indicated in hyperpiesis. In doses of 5 to 7½ grains, caffeine citrate is used for relief of the fatiguing type of headache and also for the alleviation of some cases of migraine. Caffeine has a stimulating effect on the centres of the spinal cord, exactly similar to but not as pronounced as that of strychnine.

8. *Strychnine*.—Strychnine as a 'dope' is not commonly used in this country.

*Sedatives.*—The sedative doping agents include opium, barbiturates, chloral hydrate, paraldehyde, coal tar derivatives, aspirin, bromides and valerian.

1. *Opium and its alkaloids.*—Elsewhere, we have exhaustively dealt with the opium habit in India from its various aspects. We have pointed out that there are a large number of individuals in this country who take small doses of opium occasionally, to get them through periods of strain and stress. They do not take the drug habitually but only at certain times in small doses. We have quoted examples of many persons in the Punjab who take  $\frac{1}{4}$  to 1 grain of opium, generally during the winter months with the idea that it protects them from coughs and colds. They give it up as soon as milder weather sets in. Then again there are others who take small doses of opium to enable them to cope with the strenuous work of the harvest. In such individuals opium is not a drug of addiction, but is merely a 'dope'.

2. *Barbiturates.*—Barbituric acid and its derivatives are widely used nowadays and have become a source of danger to the people in this country. Instances of their abuse are at present confined to large cities. They are excellent hypnotics and often help in procuring sleep to persons in states of anxiety, worry, and exhaustion, and also when individuals feel nervous and excited before undertaking some hazardous task. Shock due to breavement, loss in business or maladjustment of domestic affairs may induce an individual under the advice of a doctor, and sometimes independently, to take one of these drugs to allay uneasiness of mind. Preparations containing barbituric acid and hyoscyamus are known to have been used in sailing contests to prevent sea-sickness.

The present authors (Chopra and Chopra, 1935) found that although various members of this series were occasionally used to overcome the sense of mental fatigue and exhaustion, and also to combat the sense of depression and insomnia after withdrawal of drugs such as opium or alcohol, habit formation did sometimes occur after such use. Our inquiries show that certain drugs of this series are used by young licentious individuals and prostitutes for sex gratification. Persons with unstable nervous systems under worry and stress are more prone to use them, as some of the barbiturates decrease inhibitions to some extent. This is why their use is dangerous. The individual, in order to produce sound sleep at bedtime, takes a dose and feels the soothing effects and a feeling of euphoria; in order to enhance its effects he may repeat the dose. This removes inhibition, and also impairs judgment, which in turn leads to excessive indulgence or overdose which has resulted in unconsciousness and even death. It is, therefore, dangerous to use these drugs, and they should not be sold to the general public save on a prescription by a qualified physician; the dose should not be repeated except under the express order of a qualified doctor. The abstinence symptoms in the case of barbiturates are very mild, so that they can be suddenly stopped without much difficulty. They undoubtedly have bad side-effects.

2. *Chloral and paraldehyde.*—During recent years the use of chloral hydrate as a drug to induce a sense of well-being and to reduce fatigue has been reported in certain parts of India. The present authors (Chopra and Chopra, 1932) reported a number of cases

where the drug was mixed with tea or dissolved in water or a little alcohol and was habitually taken. The fact that it is cheap and easily available is responsible for the rapid spread of this habit in certain localities. The present authors have shown that the repeated use of these drugs is harmful and dangerous. Mental, moral and physical degeneration sets in earlier and is more pronounced than in the case of other drugs. We saw quite a number of cases where these drugs were taken in toxic doses by individuals on their own initiative and this led to fatal poisoning in a few instances. The symptoms of acute poisoning, as observed in our series, were prolonged and profound sleep with gradual failure of circulation. Continued administration as either a sedative or hypnotic is dangerous as personality changes may occur, as well as loss of appetite, dyspepsia, muscular weakness and tremors. Addiction is easily produced and its results are serious, frequently ending fatally in three or four hours. In habitual users, chronic poisoning occurs which leads to flushing of the face, the conjunctiva becomes yellow and there may be a sense of nervous apprehension. Gastro-intestinal disturbances, shown by thickly coated tongue, anorexia, epigastric pain, pain in the hepatic region, and diarrhoea are common effects. Others complained of a feeling of intense cold and faintness. The urinary changes were also frequent; the dark colour of the urine due to hæmoporphyria is characteristic. Skin eruptions were also seen, they consisted of an itchy sensation, and a papular rash all over the body. The sexual impulse becomes sluggish and may be followed by impotence. There may be palpitation of the heart and respiratory distress on slight exertion. If the use is not given up, the individual suffers from general cachexia and dies of exhaustion.

3. *Aromatic analgesics.*—A number of phenol derivatives are commonly used for reducing temperature, relieving headache, muscular pains, etc. Aspirin is the most popular, and thousands of tons of this drug are consumed annually. It has largely replaced phenacetin and antipyrin which were commonly used in this country two decades ago in combination with caffeine. Aspirin and cinchophen are now extensively used, chiefly the former.

Analgesic phenol derivatives reduce the perception of pain only in mild conditions; they have little action in relieving severe pain from wounds or from acute inflammation, though they certainly decrease its intensity and make it more bearable. Aspirin and coal tar derivatives are common dopes used in this country. These drugs are frequently employed by individuals who feel fatigued and yet wish to continue their work. Aspirin is usually taken in doses of 10 grains a day and it is generally mixed with a little caffeine. Various members of this series are used by the laity in Europe and America as a morning 'pick-me-up' and are freely obtainable in soda fountains as effervescent nostrums for aches and pains of all descriptions. As regards the harmful effects, their prolonged use may lead to palpitation, sweating and asthenia.

4. *Bromides and valerian.*—The practice of taking bromides habitually or occasionally is rare in India, and only a few instances of their abuse have been reported to us. Most of the

individuals who abused these drugs were old patients and here the responsibility lay on the shoulders of the doctors in charge. Moreover bromides are a common constituent of the 'patent medicines' which the neurotic, the sleepless, the depressed and persons with unstable nervous systems take so frequently.

Bromides produce a general depression of the central nervous system. Small doses affect the highest centres in the brain, the subject becoming dull and apathetic. Larger doses increase this depression and depress certain reflexes, e.g., vomiting. General sensation is little affected and they have feeble hypnotic action. On account of war conditions bromides have become expensive. Formerly, on account of their cheapness and easy availability, over-worked and excited persons who suffered from sleeplessness made use of bromides frequently.

According to Tod and Stalker most of the patients on admission to the Royal Edinburgh Hospital for mental disorders were in a toxic physical state and showed mental symptoms of a toxic kind in addition to those of the original disease; the blood often contained bromide, and the toxic symptoms disappeared when the drug was withheld. Not infrequently in the case of patients who are receiving bromides, anxiety, depression, agitation, excitement and other such symptoms become worse. A diet poor in common salt favours the retention of bromides in the system, and the impairment of the function of the kidneys also predisposes to intoxication. The clinical features of bromide intoxication are essentially those of an organic reaction type (acute or chronic, mild or severe); that is, impairment of comprehension, interference with the elaboration of impressions, defects in orientation and retention, dulling of memory, marked fluctuation in the level of attention and emotional process and even acute delirium. Typical nervous symptoms may also be present.

**Discussion.**—How far the substances exerting a calming influence on the nerves, such as valerian, bromides and drugs containing barbituric acid can be included among 'doping' agents is a question which requires discussion. Nervous disturbances of the heart, such as tachycardia caused by 'nervous' and functional disturbances of the gastro-intestinal tract, are frequent among athletes and workers employed in hazardous jobs, who have to undergo a lot of physical strain. The removal of these distressing nervous disturbances no doubt enables to a certain extent a higher standard of performance to be reached. These drugs should not be considered as true 'stimulants' or dopes as they are used by persons who are not perfectly healthy to allay certain symptoms from which they suffer. They are seldom used by labourers and individuals undergoing hard physical strain as they are likely to cause fatigue by themselves.

#### Class 'B' drugs acting on the cardiovascular system

##### (a) Circulatory depressants

**Nitroglycerine, trinitrini, etc.**—Although such drugs are known to have been used by persons competing in bicycle races in the west, they are seldom used in this country.

The present authors quite recently saw a case where nitroglycerine capsules were used for the spasm of the coronary vessels, with pain in the cardiac region and high blood pressure, by a man sixty years of age. The capsules were gradually replaced by 0.5 mgm. tablets of trinitrini (one t.d.s.) which were continued for several weeks. When an attempt was made to withdraw the drug, the patient complained of pain in the chest and a sinking sensation; bromides, barbiturates and even morphine did not relieve him. The patient continued the drug and felt so miserable without it that he gradually increased the dose to 60 tablets in a week. Such doses continued for three

weeks produced unpleasant secondary effects such as vertigo, headache, palpitation, cardiac asthma and fall of blood pressure; and eventually the patient died of circulatory collapse. This is an interesting case in which the drug no doubt relieved the feeling of distress produced by physical strain on a hypertrophied heart, but gradually led to circulatory failure, although there was a certain degree of relief during the early stages.

##### (b) Cardiac stimulants

The most commonly used drugs are camphor, cardiazol, coramine, veritol and streptol.

1. **Camphor.**—The use of camphor is frequent in this country. Camphor is one of the essential oils which exercises a powerful stimulating effect on the central nervous system. Camphor is also sometimes used as an ingredient in betel morsel, and is sometimes taken in the form of a pill. It is one of the common ingredients of stimulating confections or other such preparations of *Unani* and *Ayurvedic* medicines. It is supposed to be an agreeable cerebral excitant and is a common household remedy for fevers, cholera, dysentery, dyspepsia and colic. With doses varying from  $\frac{1}{4}$  to 2 grains the symptoms described are a pleasant aromatic smell in the mouth, feeling of warmth all over the body, and a sense of general excitement of a minor degree. Some persons become more alert and exhibit a desire for action, and there may be a rapid flow of ideas. In large doses the drug may lead to a state of intoxication and even unconsciousness.

2. **Cardiazol and coramine.**—Although they are derivatives of camphor, cardiazol and coramine are not much used in this country as dopes.

Recent pharmacological studies have shown that these drugs alleviate the sense of fatigue. They are known to have been used by athletes in other countries as stimulants and tonics. The action of cardiazol and coramine consists chiefly of stimulating effects on the cardiovascular and the central nervous systems, giving rise to a sense of well-being and happiness in exhausted individuals. They increase reflex mechanisms and stimulate the respiratory centre. Administration of large doses may give rise to muscular spasms. Their action on the circulatory system is chiefly due to stimulation of the vaso-motor and respiratory centres.

Various European workers have studied the effects of these drugs on athletes, during violent physical exercise. It has been found that after administration of the drug the pulse rate and blood pressure rise less after exertion and return to normal more readily than otherwise. The output of work is greater and symptoms of fatigue are less marked. Thus it appears that coramine and cardiazol stimulate muscular effort and relieve fatigue. No harmful effects have been so far recorded after their use in therapeutic doses.

3. **Ephedrine.**—Ephedrine in small doses acts beneficially in individuals who suffer from low blood pressure, slow pulse and slight asthenia. Such cases are quite common in the tropics, and this condition may be a premonition of epidemic dropsy. The authors have come across a few instances where tablets of ephedrine hydrochloride were habitually taken. In the case of a young man of 33 who was suffering from chronic fibroid phthisis it had been used for over 13 years. He suffered from bradycardia and as soon as the drug was withdrawn the pulse

became feeble, and there was a sinking sensation and disinclination for exertion.

### *Class 'C' drugs of endocrine origin*

The most commonly used endocrine preparations in this country are the thyroid extract, suprarenal extract, insulin, testicular and ovarian preparations.

1. *Thyroid preparations.*—The authors have found a few instances in women where this drug was being habitually used for the purpose of securing slim figures and this had very serious results in some instances. The subjects were between thirty to fifty years of age and highly neurotic. The accelerated metabolism and heightened nervous irritability produced by thyroid may overcome fatigue and produce a feeling of increased efficiency, welcomed by many debilitated individuals. Patients with a mild depression, not bad enough to interfere with the pursuit of their occupation, may be sufficiently stimulated by thyroid extract to enable them to carry on their work.

Small doses of thyroid will often cause an increase in physical vigour and mental activity, but thyroid should not be used for this purpose except for very short periods. It should also be remembered that thyroid administration causes an increased excretion of calcium and magnesium and may thus produce a negative calcium balance. Instances of habitual use of thyroid are occasionally encountered, and while easily recognized, if the symptoms are pronounced, they may escape detection when the complaints are mainly excitability, lack of stamina, and an increased tendency to fatigue. The use of this drug, except under strict medical supervision, may lead to disastrous results.

2. *Suprarenal extract.*—Intravenous injections of suprarenal cortex hormone have been recommended by Leyton (1933) for the treatment of debilitated individuals with low temperature, low blood sugar, and hypotension. We have had no personal experience of this preparation either as a tonic or as a 'dope', but have never observed any benefit resulting from the use of suprarenal gland substance by mouth. Eagle, Britton and Kline (1932) reported improvement in muscular work in case of healthy dogs which were given intraperitoneal injections of sterile protein-free extract of adrenal cortex. The more recent work of Missiuro, Dill and Edwards (1938) on adreno-cortical hormone shows that there is an improvement in efficiency, in easy walking tests after the administration of this drug. Instances of habitual or repeated use of preparations of this gland are sometimes encountered in individuals who feel tired and exhausted if they do not take this drug. Asthmatics also have been known to indulge in it habitually, but the effect mostly is psychical.

4. *Sex hormones.*—Sometimes middle-aged women during the climacteric suffer from vague symptoms such as flushes, pains in legs, high blood pressure, disinclination for mental and physical exertion, etc. In such cases ovarian hormones can be administered with beneficial results. These preparations certainly improve general health and produce mental tranquility. We have known instances where maintenance doses of such preparations as *progynon* have not only made the patient comfortable by reducing symptoms of vasomotor disturbances, such as, irritability, etc., but changed their outlook entirely for the better.

In Europe, in certain cases of women athletes, the administration of sex hormone is said to have raised the level of performance. The administration of oestrus-producing substances delayed the onset of menstruation when it coincided with the date of the contest. It is well-known that the desire for activity is greatly reduced in women during the menstrual period. Therefore an attempt was made by Okamoto and his collaborators to retard the menstrual process by means of a follicular product called 'Pelanin' in women athletes. In fifty per cent of the cases they found that 'Pelanin' administered *per os* could retard menstruation. These effects were more marked in the case of young women, but in older ones the effects were not so remarkable. When severe exertion or a contest is to be undertaken by a woman, the hormone treatment must be applied immediately before the day on which menstruation is expected to begin. Although administration of these hormones is likely to improve performance in some cases, these preparations should be avoided, as no one knows their ultimate effects.

It is often believed that the administration of male glandular hormones improves the mental and physical condition in men. These products, however, are still in the experimental stage and no immediate effects should be expected from their use.

### *Class 'D' metallic preparations*

There are two drugs belonging to this group which are used in India as stimulants and as general tonics, *viz.*, arsenic and mercury.

*Arsenic.*—In India, there are many persons who take arsenic habitually. It is sometimes given to horses to give them more energy, sharpen their appetite and to improve their appearance by improving their coat; this practice is very uncommon nowadays. The present authors, during their work on drug addiction, came across arsenic eaters in Northern India. The reason for its habitual use in some cases was curiosity, to feel the effects of a poison; others took it as a tonic and as a purifier of the blood; still others for its beneficial effect in skin diseases, to improve the complexion, as a preventive against tuberculosis, as a prophylactic against certain infectious diseases, to sharpen appetite, and as an aphrodisiac. The usual dose was 0.05 to 0.1 grain a day. The drug is generally taken mixed with butter or in sugar. Arsenic, unlike narcotics, does not give rise to euphoria or pleasant sensations and thus does not lead to any marked craving. Its use is continued simply because prolonged indulgence in it gives rise to a certain amount of habituation and also because of the belief that it improves the general constitution and health. The continued use of arsenic may give rise to poisoning which consists in disturbance of the gastrointestinal tract and the nervous system; skin eruptions, neuritis and sometimes amblyopia and garlic-like smell from the mouth. In cases of long duration, abstinence symptoms are also occasionally met with. These in severe cases consist of epigastric pain, diarrhoea, sense of fatigue, disinclination for work and sometimes even collapse.

*Mercury.*—We have met instances of the habitual use of mercurial salts in the form of indigenous preparations in this country. The most common drugs used are *shingraf* and



*makaradhwaja*. Mercury is believed to be an excellent sexual and general tonic and is sometimes habitually taken mixed with honey, or butter for such purposes. The senior author (1933) and Chopra and Mukerji (1932) have discussed fully the tonic effects of mercury when taken in the form of soluble preparations, such as *makaradhwaja*, and suggested that the minute quantities absorbed might produce stimulating effects.

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 (Part II will appear in our next issue)

## Medical News

### INDIAN RESEARCH FUND ASSOCIATION RESEARCH FELLOWSHIPS

THE attention of readers is drawn to an advertisement on p. lii for five research fellowships under the Indian Research Fund Association.

This is a new scheme under the fund to stimulate an interest in research amongst the rising generation of medical men. Schemes of proposed work must be submitted and the applications forwarded through the heads of the institutions where the applicants will work.

The heads of institutions which are equipped for research should take this opportunity to encourage suitable men to apply for these posts and give them the necessary facilities for working in their institutions.

It should be noted that the applications must be in by 7th February, 1942, so that the time is very short.

### ABSTRACT OF THE RESOLUTIONS OF THE BENGAL COUNCIL OF MEDICAL REGISTRATION AT THEIR MEETING HELD ON THE 12TH AUGUST, 1941

THE Council directed that special attention of the Government should be drawn to the following matters:—

(1) Amendment of the Bengal Medical Act, 1914, on the lines suggested by the Council from time to time since 1934;

(2) revision of the curriculum of the licentiate examination on the lines proposed in 1937, viz, with I.Sc. as the preliminary qualification and a course of five years.

(3) amendment of the Government resolution of 1938, so as to permit the Council's nominee on the Bengal Sanitary Board to be a member of the Council;

(4) necessary legislation on the lines suggested by the Council in August 1939, so as to prevent the use of the prefix 'Dr.' as a medical qualification by unqualified medical practitioners.

(5) necessary legislation on the lines suggested by the Council in August 1940, so as to prohibit teaching of Western medicine in unrecognized institutions;

(6) necessary legislation on the lines suggested by the Council in February 1941, for penalizing display of unauthorized medical diplomas, titles, etc.

With the sanction of the local Government reciprocity of registration with the Central Provinces and Berar Council for qualifications registrable under the Bengal Medical Act, was recognized.

With the sanction of the local Government, the qualifications of D.P.H. & Hy. from the Faculty of Tropical Medicine, Calcutta, and the D.O.M.S. &

D.G.O. of the Bombay College of Physicians and Surgeons, were recognized as additional qualifications of a practitioner already registered on a qualification initially registrable under the Act.

On the question of Birth Control Centres, the Council expressed the opinion that they would not be objectionable provided that they are run by properly qualified registered practitioners and provided further that they do not offend any of the existing ethical rules regarding advertisements, solicitations, etc., or the criminal laws of the country.

A registered medical practitioner who was associating himself with practitioners not registered under the Bengal Medical Act, in the teaching of clinical subjects in an Ayurvedic institution and in practice outside, was held to be a violation of Rule 3, para. 2, in Part I (warning notice) of the Ethical Rules of the Council, and his name was ordered to be removed from the Register.

### CARMICHAEL MEDICAL COLLEGE SILVER JUBILEE CELEBRATION

THE authorities of the Carmichael Medical College and Hospitals recently decided to celebrate the Silver Jubilee of the institution towards the end of last year.

It is no exaggeration to say that the establishment of this institution ushered in a new era in the realm of medical education, not only in this province alone, but in the whole of India. The creation and subsequent development of this institution proved what by tenacity and sincerity of purpose, non-official efforts could achieve.

An elaborate scheme has been prepared by the Jubilee committee and no pains are being spared to make the function a success and worthy of the nationalistic tradition of the institution.

Sir Nripendranath Sarkar has been elected chairman of the Jubilee committee. A working committee with Sir Nil Ratan Sircar as chairman and nine sectional committees have been formed to work out the details of the programme.

The authorities of the institution in celebrating the Jubilee consider the function as one of stock-taking. They look forward to the future growth and development of the institution. It cannot be denied that the institution has more than justified its existence. Its attainments and growth have been remarkable. The sacrifice of those who have toiled for its establishment does honour to the country. But much more remains to be done and everyone has a part to play in the future growth and development of the institution.

### MALARIA INSTITUTE OF INDIA

WHILST the research activities of the institute have been restricted owing to war conditions, there has been an expansion of the training courses held during the year, says the Annual Report of the Malaria Institute of India for 1940. Special courses have been arranged for military personnel, whilst for the first time malaria courses for engineers were held at the field station of the institute in Delhi. The latter were attended by 61 engineers, representing various branches of their profession, from widely separated parts of India.

Officers of the institute have continued to supervise the anti-malaria campaign which has been carried on in and around Delhi over an area of 55 square miles. Advice has also been given regarding the rural malaria schemes which are in progress in different parts of India. Special research units have carried out investigations in the Wynaad, South India, in the United Provinces, Terai and in the neighbourhood of the Chilka Lake, Orissa.

A number of publications dealing with various branches of malariology have been published by members of the staff, and advice on malaria control measures has been given to a number of workers throughout India. In addition to malaria, problems connected with filariasis and the possible introduction of yellow fever into India have been dealt with.

Fish which feed on the larvæ of mosquitoes have been supplied to various health authorities from the hatchery maintained in Delhi. A number of larvicides and insecticidal sprays have been tested at the field station, and the routine examination and identification of mosquitoes sent to the institute from different parts of India have been carried out as in previous years.

On 1st April, 1940, the public-health section of the institute was taken over by the Government of India. Prior to that date, the whole of the activities of the Malaria Institute of India were financed by the Indian Research Fund Association.

### NUTRITION

As was pointed out by Sir John Russell, who toured India a few years ago and made a comprehensive report regarding the agricultural policy to be pursued in this country, the first need was for each province to conduct nutrition surveys to discover the chief deficiencies in diet and then, with the help of the agricultural department and the rural development authorities, to encourage by all means the growth of those particular articles of food which are necessary to make up these deficiencies. Within the last few years, over 50 diet surveys have been carried out in various parts of India and the results of these surveys have been brought together in a booklet entitled 'A note on the results of diet surveys in India', issued last year by the Indian Research Fund Association.

It has been shown by experiment that a partial substitution of rice by wheat or by one of the millets grown in the country improves the diet considerably. The expansion of the cultivation of millets and the encouragement of their use by the people of rice-producing areas require the earnest consideration of the authorities. Pulses can also supply some of the important factors in which rice is deficient. The Imperial Council of Agricultural Research has initiated a co-ordinated scheme of research in the provinces in order to investigate the possibility of developing strains of higher yield as well as of encouraging the extension of areas of pulses under cultivation.

### USE OF LEAFY VEGETABLES

THE development of kitchen gardens and wider use of leafy vegetables are also desirable because these vegetables are particularly rich in vitamins A and C and in calcium and form a valuable supplement to rice diets. In India, if efficient methods such as those employed in Japan and Europe are applied to the fish industry, a

valuable supplement to the diet of the people can be provided at a low cost.

Researches carried out in the Coonoor Nutrition Research Laboratories and in some other institutions in the country have shown that certain varieties of fish available in Indian waters are particularly rich in vitamin A. A cod-liver oil substitute prepared from shark- and saw-fish-liver oils combined with groundnut oil is being prepared in Travancore, Malabar and Bombay, and, as far as the vitamin-A fraction is concerned, the replacement of cod-liver oil by these locally produced fish-liver oils has now become a practical proposition.

### IMPROVEMENT OF GRATUITIES TO EMERGENCY COMMISSIONED OFFICERS OF THE INDIAN MEDICAL SERVICE

FOLLOWING upon a recommendation of the Indian Medical Service Recruitment Conference held in July, Government have now given their sanction to gratuities on a greatly enhanced basis payable to Emergency Commissioned officers.

The minimum gratuity will be Rs. 2,000 for those who obtained their basic registrable medical qualification before the 1st January, 1940, and Rs. 1,000 for those who obtained this qualification after that date.

The minimum gratuity will be earned as soon as an officer completes his first year of service after which he will be entitled to an additional gratuity over and above this minimum, equal to one month's pay for each further completed year of service. The minimum guaranteed gratuity will be admissible to all Emergency Commissioned officers except those who on demobilization are appointed to permanent Commissions, who retain a lien on civil Government appointments or who on demobilization obtain permanent Government employment.

### THE DR. SIR BHALCHANDRA KRISHNA, KT, MEMORIAL FUND GOLD MEDAL OF THE BOMBAY MEDICAL UNION

At a meeting of the Subscribers of Sir Bhalchandra Krishna, Kt., Memorial Fund held on the 11th July, 1924, the following resolution was adopted:—

'That from the funds collected to perpetuate the memory of the late Sir Bhalchandra Krishna, Kt., a Memorial Prize Medal be founded to be awarded every year on the anniversary of his death to a member of the Medical Profession\* who submits a thesis or delivers a lecture on any medical subject before a Meeting of the Medical Profession to be held under the auspices of the Bombay Medical Union, preference to be given to one who submits any original or research work especially with reference to Indigenous Medicine on Western lines.'

In consonance with the above resolution, members of the profession are invited to submit a thesis or a paper by the 31st of March, 1942, to the undersigned for submission to a Selection Committee for making the above award.

The thesis or paper shall have to be read by the prizeman on the day of the award at a Meeting of the Profession to be held in accordance with the above Resolution.

All communications to be addressed to The Jt. Hon. Secretaries, Bombay Medical Union, Blavatsky Lodge Building, French Bridge, Chowpatty, Bombay 7.

\* A member of the Medical Profession means:—

All duly qualified Members of the Medical Profession holding degrees and diplomas from:

- (a) Indian Universities created by statute;
- (b) Such other universities and Corporate Bodies as the Managing Committee may from time to time determine subject to the approval of the General Body of the Union; and
- (c) Duly qualified Members of the Medical Profession holding diploma of Membership of the College of Physicians and Surgeons of Bombay.

## Public Health Section

### THE VILLAGE DAI AND THE RURAL HEALTH PROGRAMME

THE organization in rural areas of maternity and child welfare programmes has drawn attention to many problems concerning the need of trained persons whose services will be available to the women of rural communities during child-birth and the puerperal period, and will be available at prices within the reach of rural families.

Before beginning work and employing personnel, those who wish to organize activities to help to solve the problems must first study the local social and economic conditions, and also the various methods which have been tried in other rural areas; and, for the sake of effectiveness, they should arrange to have their activities included in a general health programme, through which attention would be given to measures designed to bring about improvement of living habits and home conditions.

Those who have studied rural India, where 90 per cent of the people of India live, know that economic conditions in the villages are such that for many years to come the family will not consider paying for the services of trained midwives.

It is impossible for any government to train and place in rural areas, within a reasonably short time, enough *properly* trained midwives to care for all the deliveries, whether on the basis of free service, subsidized service, or private practice.

Well-trained midwives or government midwives who attempt to practise in rural areas receive very small incomes and are hindered by the active opposition of the *dais* who fear that the midwives will eventually take away their practices.

Although the village *dai* has usually never had any training in midwifery or hygiene, she is trusted by the village people, and it is improbable that the village families will change their habits and discard the help of the *dais* within a short time. In many areas social customs still frown upon the employment of trained midwives.

More than 90 per cent of labours follow a physiologically normal course, but the person who delivers normal cases should know something about the value of prenatal care, the elements of hygiene, the simple technique of a hygienic delivery, the importance of non-interference, the important signs of abnormal labour, and the simple hygiene of post-partum care.

Under any programme, the quality of the service supplied and the area served will depend upon the talent, education and training of the members of the personnel, and the funds available for salaries and general expenses.

One hears frequently the statement that since the average village family is unable to pay a trained midwife, government should supply the needed services. This statement leads to the following questions :—

- (a) What services are most urgently needed ?
- (b) What is the quality of the services to be supplied ?
- (c) What is to limit the extent of the services supplied ?
- (d) Should government supply free services of this sort for all or only for indigents ?

One scheme for rural activities recommends the official training of village *dais*, and the registration and licensing of those who have completed a course of training prescribed by government. The training is given under government supervision by qualified medical practitioners or medical officers of health who are supplied with books, diagrams and materials for teaching purposes, and are instructed to hold courses consisting of twelve lecture-demonstrations in accordance with a definite syllabus. After the close of the course, a *dai* who has attended ten of the lecture-demonstrations is given a certificate and a bag containing various materials and supplies. She thus becomes officially recognized.

Another system recommends a course of one or two years' training in midwifery for young women who have an elementary school education of 7 to 10 years. These women are placed in rural areas as government midwives to supply free service. They are obliged to contend with conservatism, superstition, the opposition of the *dais*, and many other difficulties.

Since the purpose of organizing maternity and child welfare activities in rural areas is to reach as many as possible of the women, infants, and pre-school children, it has been suggested that the village *dais* might be included temporarily in a system organized to supply a service which would be acceptable to rural communities and would gradually be improved in quality.

The *dais* would be employed as usual by the people who would thus bear a share of the cost of the service, and the people would gradually learn to want better midwifery.

The system would depend upon the careful selection and the thorough training of young women who are prepared to follow thorough practical and theoretical courses in midwifery and in maternity and child-hygiene work, extending over several years, and thereafter to live and work in rural areas. They would be placed in areas in which they would organize, at convenient places in villages, centres which pregnant women could visit regularly for examination and advice, to which infants and pre-school children could be brought for weighing, examination and advice, and at which various



other activities could be carried out. They would not practise midwifery, but would give their time to centre activities, and to demonstrations and discussions through which the village *dais* would gradually learn to care for normal cases of labour in a hygienic manner, in spite of unhygienic surroundings.

The midwife would arrange for each centre, a regular period per week during which the local *dais* would take active part in drills and discussions specially designed to help them to learn thoroughly, through frequent repetition, the hygienic technique of handling a normal labour. There would be no definite courses of instruction, but the opportunity to learn to conduct a hygienic delivery despite unhygienic surroundings would be given regularly, so that all the *dais* of a neighbourhood would gradually learn this technique. The smaller the group at the meetings the better the *dais* would learn the details of the technique.

No certificates or licences would be given, and no responsibility for the work of the *dais* would be assumed.

In organizing such a service it would be necessary that the midwife immediately makes it known in the villages that she will not practise. On this basis it would be possible for her to secure the co-operation of the *dais* instead of their opposition. She must explain carefully that she will have no private practice, will not accept fees or presents of any sort, and will need her entire time and energy for the centres to which the mothers and babies will come for observation and advice.

The *dais* would gradually learn to give their normal cases better care and would also learn that it is to the advantage of their patients and to the improvement of their practice to place all abnormal cases under the care of practising midwives and physicians.

They would learn to bring their patients early in pregnancy to the centres for observation and advice by the midwife, would advise them to visit the centres at regular intervals, and would also help the mothers to bring their infants to the centres for observation.

The village women would soon learn that a labour conducted by a *dai* who has learned to work hygienically and to discard the uncomfortable activities demanded by superstition, is so much more comfortable and peaceful that all *dais* would soon find it advisable to take the opportunity to learn more modern technique.

In areas in which attempts have been made to train *dais*, experience has shown that it is very difficult indeed for physicians to teach in very simple terms. Since the village *dais* are usually not educated and certainly do not understand technical medical terms, they often fail to understand the theoretical lectures and the demonstrations. On the other hand, experience has shown that well-trained midwives can bring their language down to a more understandable level

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## CAUSES OF ABSENCE IN COLLEGE-STUDENTS\*

By V. KRISHNA ROW  
LIEUTENANT, I.M.S.

Medical Wing, Mhow (C. I.)

DURING the last 14 years while acting as medical officer of the Presidency College, Madras, the writer has been conscious of a steady deterioration in the health and physical fitness of college students. This has been shown by the increase in the incidence of physical defects as revealed by reports of routine medical examination from time to time. This led the writer to undertake a careful investigation into health status, physical fitness and the dietary habits of the students. As a part of this study, causes of absence from college were also studied. The present paper deals with this latter aspect of the problem.

A total of 2,925 leave applications during the years 1937, 1938 and 1939 were analysed. Out of the total 2,108 or 72.1 per cent referred to medical reasons. The number of application for different illnesses is shown in table I:—

TABLE I  
Medical leave applications

|                                       |       |
|---------------------------------------|-------|
| 'Fever' group .. .. .                 | 909   |
| Dental group .. .. .                  | 42    |
| Eye group .. .. .                     | 114   |
| Bowel diseases .. .. .                | 156   |
| Lung diseases .. .. .                 | 14    |
| Ear, nose and throat diseases .. .. . | 37    |
| Cold and headache .. .. .             | 422   |
| Infectious diseases .. .. .           | 49    |
| Skin diseases .. .. .                 | 62    |
| Unspecified origins .. .. .           | 209   |
| Injuries .. .. .                      | 64    |
| Diseases of heart .. .. .             | 2     |
| Diseases of kidney .. .. .            | 1     |
| Other miscellaneous causes .. .. .    | 27    |
| TOTAL NUMBER .. .. .                  | 2,108 |

\* Abridged by Editor.

(Continued from previous column)

and are patient enough to repeat demonstrations and discussions of technique as often as this may be necessary.

Through this system of temporarily including *dais* in the programme, but only for normal cases and for establishing contact between village women and the health centres, the village women will gradually learn to appreciate the services of well-trained midwives and physicians.

Any system of maternity and child-welfare work should include or be combined with other activities which are designed to improve conditions in the village homes.

The number of applicants who showed repeated illness was 260 or 12.3 per cent and these are shown in table II:—

TABLE II  
Cases of repeated illnesses

| Nature of illness |    |    | Number of illness |
|-------------------|----|----|-------------------|
| Fever             | .. | .. | 111               |
| Headache          | .. | .. | 90                |
| Cold              | .. | .. | 53                |
| Chest pain        | .. | .. | 6                 |
| TOTAL             |    |    | 260               |

Further analysis of the complaints into specific conditions is summarized in table III:—

TABLE III  
Statistics—Analysis of complaints

|                                     |  |  |       |
|-------------------------------------|--|--|-------|
| <b>Fevers</b> .. 43.12%             |  | <b>Headache</b> .. 20.02%                  |       |
| Fever .. 729                        |  | Cold and headache .. 139                   |       |
| Rheumatism .. 1                     |  | Severe headache .. 283                     |       |
| Kala-azar .. 1                      |  |  | 422   |
| Filarial fever .. 1                 |  |  |       |
| Influenza .. 83                     |  |  |       |
| Malaria .. 38                       |  |  |       |
| Typhoid .. 3                        |  |  |       |
| Fever and cough .. 53               |  | Dental trouble .. 53                       | 1.96% |
|                                     |  | Ear, nose and throat affections .. 13      | 1.75% |
|                                     |  | Sore-throat .. 17                          |       |
|                                     |  | Tonsils .. 7                               |       |
|                                     |  | Earache .. 7                               |       |
|                                     |  |  | 37    |
| <b>Bowel diseases</b> .. 7.40%      |  | <b>Lung diseases</b> .. 0.66%              |       |
| Appendicitis .. 2                   |  | Pain in the chest .. 10                    |       |
| Intestinal colic .. 2               |  | Pneumonia .. 1                             |       |
| Intestinal troubles .. 11           |  | Asthma .. 1                                |       |
| Gastritis .. 4                      |  | Tuberculosis .. 2                          |       |
| Stomach ache .. 72                  |  |  | 14    |
| Stomach trouble .. 5                |  |  |       |
| Diarrhoea .. 15                     |  |  |       |
| Dysentery .. 40                     |  |  |       |
| Jaundice .. 4                       |  |  |       |
| Stomatitis .. 1                     |  |  |       |
|                                     |  |  | 156   |
|                                     |  | <b>Other miscellaneous causes</b> .. 1.28% |       |
|                                     |  | Neuritis .. 1                              |       |
|                                     |  | To consult doctor .. 17                    |       |
|                                     |  | Medical treatment .. 1                     |       |
|                                     |  | Inoculation .. 8                           |       |
|                                     |  |  | 27    |
| <b>Eye diseases</b> .. 5.41%        |  | <b>Diseases of heart</b> ..                |       |
| Eye pain .. 36                      |  | Valvular disease of heart .. 1             |       |
| Eye trouble .. 78                   |  | Low blood pressure .. 1                    |       |
|                                     |  |  | 2     |
|                                     |  |  |       |
| <b>Injuries</b> .. 3.04%            |  | <b>Diseases of kidney</b> .. 1             |       |
| Injuries and sprain .. 64           |  | Unspecified causes .. 70                   | 9.91% |
|                                     |  | Biliousness and giddiness .. 38            |       |
|                                     |  | Sick .. 4                                  |       |
|                                     |  | Indisposed .. 97                           |       |
|                                     |  |  | 209   |
| <b>Skin diseases</b> .. 2.94%       |  |  |       |
| Boils and abscesses .. 62           |  |  |       |
| <b>Infectious diseases</b> .. 2.23% |  |  |       |
| Mumps .. 40                         |  |  |       |
| Diphtheria .. 2                     |  |  |       |
| Smallpox .. 7                       |  |  |       |
|                                     |  |  | 49    |

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## PHYSICAL EFFICIENCY TEST OF SCHNEIDER ON BOMBAY MEDICAL STUDENTS

### PART I

By D. M. TELANG

(From the Physiological Laboratory, Grant Medical College, Bombay)

THIS test was suggested and published by Schneider in 1920 and later slightly revised by him in 1923 (Schneider, 1920, 1939). It is chiefly meant for assessing the circulatory efficiency of an individual and indirectly his physical efficiency. It is also said to give a quantitative idea of the degree of fatigue. It has been adopted as a test for recruitment to the American Air Service (Scott, 1921).

The reactions of the cardiovascular or neuro-circulatory apparatus to postural changes of the body or to exercise have been considered as criteria of circulatory efficiency for a long time. The reactions are shown by changes either in the rate of the pulse or in the blood pressure. It is held that the lower the variation of the pulse rate from the resting figure, the better the circulatory and physical stability and efficiency of the individual. Another factor is the quickness with which the body adapts its vital processes to a change in its internal or external surroundings; the rapidity with which the pulse rate returns to the resting level, if it departs from this during activity, is therefore held to be a good index of an efficient circulation and physique. The third factor is the blood pressure, and it changes in response to changes of posture or to exercise.

Schneider (1920) has tried to give a quantitative value to this efficiency by arbitrarily choosing six of these factors and allotting to each factor a certain score. When all the six factors are taken into consideration the six scores are added together and their algebraic sum gives the final rating.

(Continued from previous column)

### Conclusion

The chief causes of sickness among students are—(i) fevers, (ii) cold and headache, and (iii) bowel complaints. This is in striking agreement with the chief causes of mortality among the population, namely, fevers, respiratory diseases and bowel diseases. It shows that if these conditions are treated early they will not develop into serious illness and be the cause of death in later life.

This study also shows that women students fall ill more frequently than male students.

It is suggested that early preventive measures directed against many minor complaints will go a long way in insuring better health for the community. There is necessity for laying down a definite health policy with a view to improving physical fitness, particularly during the early years of life—infancy to adolescence.

The six factors to which points are allotted are: (1) the reclining pulse rate, (2) the standing pulse rate, (3) the difference between the standing and the reclining pulse rates, (4) the difference between the standing and the post-exercise rates, (5) the time of return of the pulse from the post-exercise to the standing rate, and (6) the difference between the standing and the reclining systolic pressures.

### Method

The actual test was performed as follows and practically as recommended by Schneider (1939):—

The subject—all were medical students between the ages of 18 and 29—was asked to come for the test at least two hours after a meal, refreshment, or smoke. He was then made to lie down on a couch for at least five minutes. In this position the pulse was counted every fifteen seconds till two consecutive readings were the same. This multiplied by four was recorded as the reclining pulse rate per minute (column 4, table II).

The systolic pressure in the same position was then noted down, taking the mean of two or three readings by the auscultatory method (column 10, table II). The instrument used was the B.D. blood pressure floor unit.

The subject with the sphygmomanometer cuff still on was then asked to rise from the bed gently and stand for two minutes to allow the pulse to become steady. The pulse was then counted for every fifteen seconds as before till two consecutive readings were equal and the figure multiplied by four was recorded as the standing pulse rate per minute (column 5, table II).

The increase in the rate on standing was recorded as so many beats per minute ranging from zero when there was no difference between the standing and the reclining rate (column 6, table II).

The standing systolic pressure was then recorded as before, the mean of two or three readings, and its variation, *plus* or *minus*, from the reclining pressure recorded separately as the difference between the two (column 11, table II).

The subject was next asked to step up and down a stool 18½ inches in height five times in fifteen seconds. This exercise was accurately timed by the stop-watch for five counts. The subject was asked to keep his left foot on the stool from the beginning of count 'one' to the end of count 'five'. At every count he was to lift his right foot up and down on to the stool and again on to the ground at the calls 'up' and 'down', respectively, the double movement making one count. At the end of count five both feet had to be down on the floor.

At the end of the fifteen seconds' period of exercise the pulse was counted, and the pulse count was repeated every fifteen seconds for the following two minutes.

The shortest time in seconds of the return of the pulse to the standing rate was noted from this (column 8, table II):

The pulse count for the first period of fifteen seconds after the end of the exercise multiplied by four gave the maximum rate per minute attained by the pulse as a result of that exercise (column 7, table II) and the difference between this and the normal standing rate was recorded for scoring (column 8, table II).

The final rating of the points was done by a reference to the score table given by Schneider (1939), table I. In this table the scores for factors (3) and (4) given above range from +3 to -3, that for factor (5) ranges from +3 to -2, and those for the remaining factors (1), (2) and (6) range from +3 to -1. The gradation of the efficiency thus ranges between the extremes of +18 and -11 in any given case when all the factors are considered together.

The subject's previous history regarding athletic and other habits, sleep during the previous night, diet, etc., was inquired into and anything worth while noted down. Observations made on those subjects who gave no history of any recent illness, however trivial, and who had a good previous night's rest have alone been included here.

### Results and discussion

The data obtained on 122 healthy male medical students—age group 18 to 29—are given in table II.

The statistical constants of these data are given in table III. It will be seen that most of them have a fairly normal distribution.

The physiological measurements, such as the pulse rate and the systolic pressure under different conditions of body posture and activity, do not show much variability amongst individuals as shown by the relatively low coefficient of variation of between 7 and 11 per cent for the reclining pulse, the standing pulse, the post-exercise pulse and the reclining and standing systolic pressures.

The high variability shown by the difference between the standing and the reclining pulse rates, the difference between the post-exercise and the standing pulse rates, and the difference between the standing and the reclining systolic pressures suggest however that the neuro-circulatory responses to postural changes and to activity of different individuals vary very much.

The most variable of these seems to be the response of the systolic blood pressure to the standing posture, the coefficient of variation in which was extremely high, *viz.*, 116 per cent.

The variability of the time of return of the post-exercise pulse to the pre-exercise level was also high.

The range of the Schneider rating was 8 to 16 with the mean at  $12.53 \pm 0.13$  and standing deviation  $2.13 \pm 0.09$ . Its coefficient of variation

TABLE I\*

*Points of grading cardiovascular changes (Schneider index)*

| A. RECLINING, PULSE RATE                                     |        |  |  | B. PULSE RATE INCREASE ON STANDING                       |                   |                   |                   |                   |
|--|--------|--|--|--|-------------------|-------------------|-------------------|-------------------|
|  |        |  |  | 0 to 10<br>beats   | 11 to 18<br>beats | 19 to 26<br>beats | 27 to 34<br>beats | 35 to 42<br>beats |
|  | Points |  |  | Points   | Points            | Points            | Points            | Points            |
| 50 to 60 .. .. .   | 3      |  |  | 3  | 3                 | 2                 | 1                 | 0                 |
| 61 to 70 .. .. .   | 3      |  |  | 3  | 2                 | 1                 | 0                 | -1                |
| 71 to 80 .. .. .   | 2      |  |  | 3  | 2                 | 0                 | -1                | -2                |
| 81 to 90 .. .. .   | 1      |  |  | 2  | 1                 | -1                | -2                | -3                |
| 91 to 100 .. .. .  | 0      |  |  | 1  | 0                 | -2                | -3                | -3                |
| 101 to 110 .. .. .   | -1     |  |  | 0  | -1                | -3                | -3                | -3                |
| C. STANDING, PULSE RATE                                      |        |  |  | D. PULSE RATE INCREASE IMMEDIATELY AFTER EXERCISE        |                   |                   |                   |                   |
|  |        |  |  | 0 to 10<br>beats   | 11 to 20<br>beats | 21 to 30<br>beats | 31 to 40<br>beats | 41 to 50<br>beats |
|  | Points |  |  | Points   | Points            | Points            | Points            | Points            |
| 60 to 70 .. .. .   | 3      |  |  | 3  | 3                 | 2                 | 1                 | 0                 |
| 71 to 80 .. .. .   | 3      |  |  | 3  | 2                 | 1                 | 0                 | 0                 |
| 81 to 90 .. .. .   | 2      |  |  | 3  | 2                 | 1                 | 0                 | -1                |
| 91 to 100 .. .. .  | 1      |  |  | 2  | 1                 | 0                 | -1                | -2                |
| 101 to 110 .. .. .   | 1      |  |  | 1  | 0                 | -1                | -2                | -3                |
| 111 to 120 .. .. .   | 0      |  |  | 1  | -1                | -2                | -3                | -3                |
| 121 to 130 .. .. .   | 0      |  |  | 0  | -2                | -3                | -3                | -3                |
| 131 to 140 .. .. .   | -1     |  |  | 0  | -3                | -3                | -3                | -3                |
| E. RETURN OF PULSE RATE TO STANDING NORMAL<br>AFTER EXERCISE |        |  |  | F. SYSTOLIC PRESSURE STANDING COMPARED WITH<br>RECLINING |                   |                   |                   |                   |
|  |        |  |  |  |                   |                   |                   |                   |
|  | Points |  |  |  |                   |                   |                   | Points            |
| 0 to 30 seconds .. .. .                                      | 3      |  |  | Rise of 8 mm. or more, .. .. .                           |                   |                   |                   | 3                 |
| 31 to 60 " .. .. .   | 2      |  |  | Rise of 2 to 7 mm. .. .. .                               |                   |                   |                   | 2                 |
| 61 to 90 " .. .. .   | 1      |  |  | No rise .. .. .  |                   |                   |                   | 1                 |
| 91 to 120 " .. .. .  | 0      |  |  | Fall of 2 to 5 mm. .. .. .                               |                   |                   |                   | 0                 |
| After 120 seconds: 2 to 10 beats above<br>normal.            | -1     |  |  | Fall of 6 mm. or more .. .. .                            |                   |                   |                   | -1                |
| After 120 seconds: 11 to 30 beats above<br>normal.           | -2     |  |  |  |                   |                   |                   |                   |

\* At the suggestion of Dr. K. V. Krishnan the table has been added.—EDITOR, I. M. G.

TABLE II  
Data of Schneider rating

| (1) Serial number | (2) Subject | (3) Age (years) | (4) Reclining pulse (per minute) | (5) Standing pulse (per minute) | (6) Difference between (4) and (5) | (7) Maximum pulse after exercise (per minute) | (8) Difference between (5) and (7) | (9) Time of return of pulse to standing (sec.) | (10) Reclining systolic blood pressure (mm. Hg.) | (11) Standing systolic blood pressure (mm. Hg.) | (12) Difference between (10) and (11) | (13) Schneider rating (points) |
|-------------------|-------------|-----------------|----------------------------------|---------------------------------|------------------------------------|---|------------------------------------|--|--|---|---------------------------------------|--------------------------------|
| 1                 | B.K.N.      | 20              | 76                               | 86                              | 10                                 | 100   | 14                                 | 90   | 120  | 116   | - 4                                   | 10                             |
| 2                 | V.J.K.      | 19              | 76                               | 88                              | 12                                 | 106   | 18                                 | 60   | 122  | 128   | 6                                     | 12                             |
| 3                 | R.M.C.      | 20              | 72                               | 84                              | 12                                 | 96  | 12                                 | 60   | 128  | 134   | 6                                     | 12                             |
| 4                 | A.K.S.      | 20              | 68                               | 76                              | 8                                  | 88  | 12                                 | 90   | 116  | 124   | 8                                     | 15                             |
| 5                 | S.R.D.      | 18              | 76                               | 84                              | 8                                  | 108   | 24                                 | 120  | 124  | 124   | 0                                     | 9                              |
| 6                 | K.R.R.      | 20              | 72                               | 88                              | 16                                 | 112   | 24                                 | 75   | 112  | 112   | 0                                     | 9                              |
| 7                 | L.U.K.      | 19              | 84                               | 84                              | 0                                  | 92  | 8                                  | 45   | 112  | 126   | 14                                    | 14                             |
| 8                 | I.A.        | 20              | 62                               | 69                              | 7                                  | 76  | 7                                  | 75   | 110  | 116   | 6                                     | 15                             |
| 9                 | B.          | 21              | 60                               | 76                              | 16                                 | 100   | 24                                 | 60   | 108  | 108   | 0                                     | 13                             |
| 10                | Z.K.K.      | 18              | 66                               | 76                              | 10                                 | 92  | 16                                 | 60   | 126  | 128   | 2                                     | 15                             |
| 11                | H.A.R.      | 20              | 64                               | 76                              | 12                                 | 92  | 16                                 | 60   | 112  | 122   | 10                                    | 15                             |
| 12                | L.H.V.      | 21              | 64                               | 78                              | 14                                 | 88  | 10                                 | 75   | 118  | 124   | 6                                     | 14                             |
| 13                | C.H.P.      | 23              | 72                               | 88                              | 16                                 | 104   | 16                                 | 45   | 112  | 120   | 8                                     | 13                             |
| 14                | K.H.S.      | 22              | 74                               | 88                              | 14                                 | 100   | 12                                 | 60   | 110  | 120   | 10                                    | 13                             |
| 15                | C.B.P.      | 23              | 72                               | 76                              | 4                                  | 104   | 28                                 | 120  | 122  | 126   | 4                                     | 9                              |
| 16                | H.B.        | 23              | 72                               | 80                              | 8                                  | 92  | 12                                 | 45   | 116  | 112   | - 4                                   | 12                             |
| 17                | D.H.M.      | 21              | 54                               | 80                              | 26                                 | 98  | 18                                 | 120  | 122  | 128   | 6                                     | 11                             |
| 18                | B.K.K.      | 21              | 82                               | 84                              | 2                                  | 100   | 16                                 | 60   | 110  | 120   | 10                                    | 12                             |
| 19                | Y.G.G.      | 21              | 78                               | 88                              | 10                                 | 106   | 18                                 | 45   | 128  | 128   | 0                                     | 12                             |
| 20                | M.          | 22              | 80                               | 88                              | 8                                  | 92  | 4                                  | 45   | 120  | 126   | 6                                     | 11                             |
| 21                | J.          | 24              | 68                               | 76                              | 8                                  | 96  | 20                                 | 45   | 112  | 120   | 8                                     | 16                             |
| 22                | N.G.S.      | 22              | 64                               | 84                              | 20                                 | 96  | 12                                 | 75   | 102  | 108   | 6                                     | 11                             |
| 23                | M.D.D.      | 25              | 64                               | 80                              | 16                                 | 104   | 24                                 | 90   | 114  | 122   | 8                                     | 12                             |
| 24                | M.D.W.      | 19              | 68                               | 88                              | 20                                 | 100   | 12                                 | 30   | 110  | 110   | 0                                     | 12                             |
| 25                | Y.J.F.      | 29              | 84                               | 88                              | 4                                  | 100   | 12                                 | 90   | 138  | 138   | 0                                     | 9                              |
| 26                | H.M.T.      | 21              | 72                               | 88                              | 16                                 | 112   | 24                                 | 75   | 120  | 130   | 10                                    | 11                             |
| 27                | H.P.        | 23              | 72                               | 76                              | 4                                  | 88  | 12                                 | 60   | 126  | 142   | 16                                    | 15                             |
| 28                | C.D.T.      | 21              | 56                               | 68                              | 12                                 | 90  | 22                                 | 75   | 112  | 112   | 0                                     | 14                             |
| 29                | B.          | 21              | 76                               | 88                              | 12                                 | 102   | 14                                 | 60   | 124  | 128   | 4                                     | 12                             |
| 30                | AGM.        | 24              | 76                               | 88                              | 12                                 | 104   | 16                                 | 60   | 124  | 124   | 0                                     | 11                             |
| 31                | G.J.A.      | 21              | 80                               | 100                             | 20                                 | 108   | 8                                  | 45   | 124  | 130   | 6                                     | 9                              |
| 32                | S.G.D.      | 22              | 56                               | 80                              | 24                                 | 96  | 16                                 | 60   | 112  | 116   | 4                                     | 14                             |
| 33                | L.N.D.      | 18              | 80                               | 96                              | 16                                 | 108   | 12                                 | 45   | 122  | 128   | 6                                     | 10                             |
| 34                | N.S.D.      | 19              | 56                               | 68                              | 12                                 | 76  | 8                                  | 45   | 110  | 112   | 2                                     | 16                             |
| 35                | T.          | 22              | 74                               | 88                              | 14                                 | 104   | 16                                 | 60   | 116  | 118   | 2                                     | 12                             |
| 36                | C.D.D.      | 19              | 62                               | 88                              | 26                                 | 100   | 12                                 | 75   | 100  | 112   | 12                                    | 12                             |
| 37                | M.P.D.      | 23              | 76                               | 92                              | 16                                 | 100   | 8                                  | 60   | 128  | 140   | 12                                    | 12                             |
| 38                | P.P.S.      | 21              | 68                               | 76                              | 8                                  | 92  | 16                                 | 75   | 120  | 126   | 6                                     | 14                             |
| 39                | M.A.J.      | 22              | 76                               | 92                              | 16                                 | 100   | 8                                  | 30   | 124  | 136   | 12                                    | 13                             |
| 40                | S.          | 23              | 68                               | 84                              | 16                                 | 108   | 24                                 | 60   | 108  | 110   | 2                                     | 12                             |
| 41                | N.          | 18              | 76                               | 84                              | 8                                  | 112   | 28                                 | 60   | 120  | 124   | 4                                     | 12                             |
| 42                | MSA.        | 23              | 80                               | 88                              | 8                                  | 104   | 16                                 | 60   | 114  | 126   | 12                                    | 14                             |
| 43                | R.J.M.      | 20              | 72                               | 88                              | 16                                 | 104   | 16                                 | 45   | 102  | 118   | 16                                    | 13                             |
| 44                | F.N.G.      | 19              | 72                               | 84                              | 12                                 | 104   | 20                                 | 60   | 110  | 120   | 10                                    | 13                             |
| 45                | A.J.V.      | 20              | 62                               | 80                              | 18                                 | 96  | 16                                 | 60   | 120  | 128   | 8                                     | 15                             |
| 46                | K.A.M.      | 26              | 88                               | 88                              | 0                                  | 116   | 28                                 | 75   | 114  | 120   | 6                                     | 9                              |
| 47                | D.          | 20              | 52                               | 76                              | 24                                 | 100   | 24                                 | 60   | 110  | 116   | 6                                     | 13                             |
| 48                | A.C.K.      | 21              | 64                               | 72                              | 8                                  | 84  | 12                                 | 45   | 106  | 118   | 12                                    | 16                             |
| 49                | C.H.L.      | 22              | 68                               | 80                              | 12                                 | 102   | 22                                 | 60   | 116  | 124   | 8                                     | 14                             |
| 50                | J.N.V.      | 20              | 72                               | 92                              | 20                                 | 100   | 8                                  | 30   | 108  | 108   | 0                                     | 9                              |
| 51                | N.          | 19              | 76                               | 88                              | 12                                 | 108   | 20                                 | 60   | 116  | 126   | 10                                    | 13                             |
| 52                | K.K.K.      | 21              | 68                               | 76                              | 8                                  | 104   | 28                                 | 120  | 110  | 110   | 0                                     | 10                             |
| 53                | S.V.B.      | 21              | 64                               | 80                              | 16                                 | 88  | 8                                  | 45   | 104  | 110   | 6                                     | 15                             |
| 54                | B.          | 19              | 72                               | 84                              | 12                                 | 112   | 28                                 | 45   | 114  | 120   | 6                                     | 11                             |
| 55                | H.          | 22              | 68                               | 92                              | 24                                 | 112   | 20                                 | 45   | 116  | 130   | 14                                    | 11                             |
| 56                | P.          | 21              | 76                               | 76                              | 0                                  | 88  | 12                                 | 45   | 112  | 120   | 8                                     | 15                             |
| 57                | A.          | 20              | 68                               | 88                              | 20                                 | 108   | 20                                 | 60   | 106  | 106   | 0                                     | 11                             |
| 58                | U.          | 20              | 68                               | 84                              | 16                                 | 104   | 20                                 | 45   | 124  | 130   | 6                                     | 13                             |
| 59                | M.A.P.      | 21              | 70                               | 74                              | 4                                  | 90  | 16                                 | 60   | 118  | 120   | 2                                     | 15                             |
| 60                | H.          | 21              | 68                               | 84                              | 16                                 | 104   | 20                                 | 90   | 112  | 116   | 4                                     | 12                             |

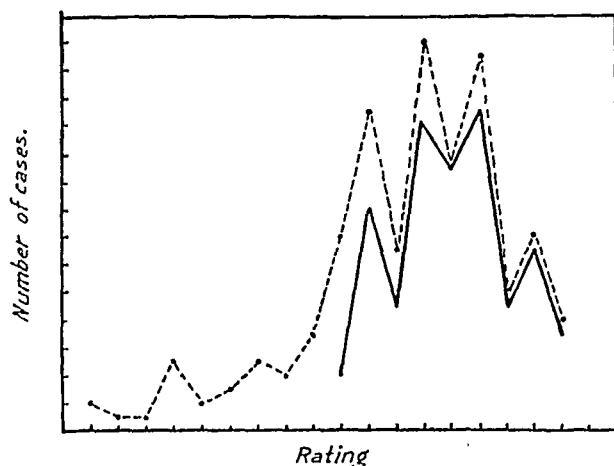
TABLE II—*concl'd.*

| (1) Serial number | (2) Subject | (3) Age (years) | (4) Reclining pulse (per minute) | (5) Standing pulse (per minute) | (6) Difference between (4) and (5) | (7) Maximum pulse after exercise (per minute) | (8) Difference between (5) and (7) | (9) Time of return of pulse to standing (sec.) | (10) Reclining systolic blood pressure (mm. Hg.) | (11) Standing systolic blood pressure (mm. Hg.) | (12) Difference between (10) and (11) | (13) Schneider rating (points) |
|-------------------|-------------|-----------------|----------------------------------|---------------------------------|------------------------------------|---|------------------------------------|--|--|---|---------------------------------------|--------------------------------|
| 61                | N.          | 23              | 60                               | 80                              | 20                                 | 82  | 2                                  | 15   | 126  | 116   | - 10                                  | 13                             |
| 62                | A.M.K.      | 22              | 64                               | 84                              | 20                                 | 100   | 16                                 | 45   | 124  | 124   | 0                                     | 11                             |
| 63                | C.A.P.      | 22              | 68                               | 76                              | 8                                  | 96  | 20                                 | 45   | 122  | 120   | - 2                                   | 13                             |
| 64                | H.T.C.      | 27              | 76                               | 92                              | 16                                 | 100   | 8                                  | 45   | 114  | 120   | 6                                     | 11                             |
| 65                | S.V.A.      | 22              | 84                               | 84                              | 0                                  | 100   | 16                                 | 60   | 118  | 124   | 6                                     | 11                             |
| 66                | N.A.D.      | 22              | 68                               | 88                              | 20                                 | 88  | 0                                  | 0  | 116  | 120   | 4                                     | 14                             |
| 67                | CL.J.       | 22              | 64                               | 88                              | 24                                 | 96  | 8                                  | 60   | 126  | 126   | 0                                     | 12                             |
| 68                | M.M.P.      | 22              | 72                               | 90                              | 18                                 | 100   | 10                                 | 120  | 114  | 116   | 2                                     | 11                             |
| 69                | S.N.R.      | 20              | 74                               | 92                              | 18                                 | 108   | 16                                 | 45   | 118  | 120   | 2                                     | 10                             |
| 70                | M.W.P.      | 20              | 84                               | 94                              | 10                                 | 108   | 14                                 | 50   | 126  | 132   | 6                                     | 9                              |
| 71                | D.S.D.      | 21              | 68                               | 80                              | 12                                 | 104   | 24                                 | 60   | 124  | 130   | 6                                     | 13                             |
| 72                | R.L.D.      | 20              | 64                               | 84                              | 20                                 | 98  | 14                                 | 75   | 112  | 112   | 0                                     | 11                             |
| 73                | S.M.W.      | 22              | 88                               | 96                              | 8                                  | 116   | 20                                 | 30   | 142  | 148   | 6                                     | 10                             |
| 74                | C.A.S.      | 22              | 62                               | 64                              | 2                                  | 92  | 28                                 | 60   | 120  | 122   | 2                                     | 15                             |
| 75                | D.N.P.      | 23              | 72                               | 84                              | 12                                 | 104   | 20                                 | 60   | 122  | 130   | 8                                     | 13                             |
| 76                | A.          | 24              | 84                               | 90                              | 6                                  | 110   | 20                                 | 45   | 122  | 128   | 6                                     | 11                             |
| 77                | R.          | 23              | 72                               | 80                              | 8                                  | 100   | 20                                 | 60   | 118  | 130   | 12                                    | 15                             |
| 78                | G.A.V.      | 20              | 72                               | 84                              | 12                                 | 108   | 24                                 | 90   | 118  | 118   | 0                                     | 9                              |
| 79                | C.V.D.      | 21              | 84                               | 96                              | 12                                 | 108   | 12                                 | 45   | 110  | 122   | 12                                    | 9                              |
| 80                | M.P.M.      | 22              | 72                               | 80                              | 8                                  | 100   | 20                                 | 75   | 136  | 120   | - 16                                  | 10                             |
| 81                | H.C.J.      | 20              | 60                               | 90                              | 30                                 | 102   | 12                                 | 75   | 102  | 108   | 6                                     | 11                             |
| 82                | V.D.B.      | 24              | 72                               | 84                              | 12                                 | 100   | 16                                 | 45   | 102  | 116   | 14                                    | 13                             |
| 83                | O.          | 21              | 74                               | 78                              | 4                                  | 108   | 30                                 | 90   | 130  | 144   | 14                                    | 13                             |
| 84                | K.          | 21              | 80                               | 84                              | 4                                  | 104   | 20                                 | 45   | 130  | 130   | 0                                     | 12                             |
| 85                | D.          | 20              | 68                               | 88                              | 20                                 | 100   | 12                                 | 45   | 114  | 122   | 8                                     | 13                             |
| 86                | K.N.D.      | 24              | 88                               | 96                              | 8                                  | 104   | 8                                  | 60   | 116  | 130   | 14                                    | 11                             |
| 87                | M.          | 22              | 68                               | 76                              | 8                                  | 96  | 20                                 | 60   | 120  | 132   | 12                                    | 16                             |
| 88                | D.P.U.      | 18              | 72                               | 92                              | 20                                 | 100   | 8                                  | 30   | 116  | 130   | 14                                    | 11                             |
| 89                | J.F.B.      | 18              | 72                               | 80                              | 8                                  | 92  | 12                                 | 45   | 124  | 124   | 0                                     | 13                             |
| 90                | A.          | 20              | 76                               | 92                              | 16                                 | 108   | 16                                 | 60   | 118  | 118   | 0                                     | 9                              |
| 91                | M.M.A.      | 23              | 64                               | 80                              | 16                                 | 100   | 20                                 | 60   | 118  | 102   | - 16                                  | 11                             |
| 92                | F.          | 23              | 62                               | 76                              | 14                                 | 84  | 8                                  | 45   | 102  | 106   | 4                                     | 15                             |
| 93                | R.K.P.      | 21              | 72                               | 92                              | 20                                 | 104   | 12                                 | 30   | 128  | 138   | 10                                    | 10                             |
| 94                | A.V.G.      | 20              | 72                               | 96                              | 24                                 | 160   | 4                                  | 30   | 104  | 114   | 10                                    | 11                             |
| 95                | A.J.S.      | 25              | 84                               | 84                              | 0                                  | 104   | 20                                 | 75   | 126  | 130   | 4                                     | 10                             |
| 96                | L.S.S.      | 25              | 68                               | 88                              | 20                                 | 104   | 16                                 | 60   | 104  | 108   | 4                                     | 12                             |
| 97                | M.K.T.      | 22              | 72                               | 84                              | 12                                 | 100   | 16                                 | 60   | 120  | 124   | 4                                     | 12                             |
| 98                | G.D.D.      | 22              | 72                               | 84                              | 12                                 | 100   | 16                                 | 60   | 112  | 124   | 12                                    | 13                             |
| 99                | S.B.N.      | 23              | 56                               | 64                              | 8                                  | 92  | 28                                 | 60   | 108  | 120   | 12                                    | 16                             |
| 100               | R.N.G.      | 21              | 64                               | 72                              | 8                                  | 96  | 24                                 | 60   | 126  | 126   | 0                                     | 13                             |
| 101               | L.N.J.      | 22              | 68                               | 88                              | 20                                 | 96  | 8                                  | 45   | 104  | 108   | 4                                     | 13                             |
| 102               | C.J.D.      | 20              | 54                               | 70                              | 16                                 | 90  | 20                                 | 60   | 102  | 106   | 4                                     | 16                             |
| 103               | C.M.P.      | 20              | 60                               | 68                              | 8                                  | 88  | 20                                 | 75   | 116  | 118   | 2                                     | 15                             |
| 104               | B.S.P.      | 21              | 76                               | 88                              | 12                                 | 112   | 24                                 | 75   | 128  | 128   | 0                                     | 9                              |
| 105               | J.N.V.      | 20              | 72                               | 88                              | 16                                 | 104   | 16                                 | 60   | 116  | 124   | 8                                     | 13                             |
| 106               | J.M.S.      | 20              | 80                               | 88                              | 8                                  | 108   | 20                                 | 90   | 106  | 108   | 2                                     | 12                             |
| 107               | V.S.P.      | 20              | 60                               | 72                              | 12                                 | 84  | 12                                 | 45   | 116  | 124   | 8                                     | 16                             |
| 108               | W.          | 21              | 72                               | 96                              | 24                                 | 108   | 12                                 | 45   | 108  | 110   | 2                                     | 9                              |
| 109               | M.R.D.      | 21              | 72                               | 88                              | 16                                 | 96  | 8                                  | 30   | 116  | 120   | 4                                     | 14                             |
| 110               | H.M.P.      | 20              | 64                               | 80                              | 16                                 | 100   | 20                                 | 75   | 114  | 116   | 2                                     | 13                             |
| 111               | N.C.D.      | 24              | 88                               | 100                             | 12                                 | 120   | 20                                 | 60   | 116  | 128   | 12                                    | 9                              |
| 112               | V.A.P.      | 21              | 88                               | 100                             | 12                                 | 116   | 16                                 | 45   | 112  | 116   | 4                                     | 8                              |
| 113               | C.N.M.      | 21              | 88                               | 96                              | 8                                  | 112   | 16                                 | 60   | 112  | 124   | 12                                    | 10                             |
| 114               | S.J.A.      | 18              | 84                               | 92                              | 8                                  | 112   | 20                                 | 60   | 124  | 126   | 2                                     | 9                              |
| 115               | B.H.W.      | 20              | 80                               | 92                              | 12                                 | 124   | 32                                 | 45   | 132  | 138   | 6                                     | 8                              |
| 116               | P.C.K.      | 21              | 84                               | 92                              | 8                                  | 108   | 16                                 | 45   | 114  | 116   | 2                                     | 9                              |
| 117               | N.M.G.      | 21              | 68                               | 96                              | 28                                 | 116   | 20                                 | 90   | 120  | 124   | 4                                     | 8                              |
| 118               | R.S.D.      | 23              | 76                               | 84                              | 8                                  | 112   | 28                                 | 90   | 110  | 112   | 2                                     | 11                             |
| 119               | M.G.A.      | 20              | 76                               | 96                              | 20                                 | 116   | 20                                 | 60   | 112  | 114   | 2                                     | 8                              |
| 120               | J.          | 21              | 88                               | 88                              | 0                                  | 108   | 20                                 | 60   | 130  | 132   | 2                                     | 11                             |
| 121               | K.K.B.      | 21              | 76                               | 84                              | 8                                  | 104   | 20                                 | 60   | 96   | 100   | 4                                     | 13                             |
| 122               | S.J.P.      | 20              | 76                               | 84                              | 8                                  | 96  | 12                                 | 45   | 128  | 126   | - 2                                   | 11                             |

TABLE III  
Statistical constants of data

| Data  | Range      | Mean + P.E.       | Standard deviation $\pm$ P.E. | Coefficient of variation % $\pm$ P.E. |
|---|------------|-------------------|-------------------------------|---------------------------------------|
| 1. Age .. ..                                    | 18-29      | 21.78 $\pm$ 0.11  | 1.82 $\pm$ 0.08               | 8.3 $\pm$ 0.36                        |
| 2. Reclining pulse (per minute) ..              | 52-88      | 73.4 $\pm$ 0.51   | 8.44 $\pm$ 0.37               | 11.5 $\pm$ 0.501                      |
| 3. Standing pulse (per minute) ..               | 64-100     | 86.24 $\pm$ 0.47  | 7.76 $\pm$ 0.34               | 9.0 $\pm$ 0.39                        |
| 4. Difference between (2) and (3) ..            | 0-30       | 14.48 $\pm$ 0.39  | 6.48 $\pm$ 0.28               | 44.7 $\pm$ 2.274                      |
| 5. Maximum pulse after exercise (per minute).   | 76-124     | 101.5 $\pm$ 0.53  | 8.7 $\pm$ 0.38                | 8.5 $\pm$ 0.368                       |
| 6. Difference between (5) and (3) ..            | 0-32       | 18.28 $\pm$ 0.39  | 6.44 $\pm$ 0.28               | 35.2 $\pm$ 1.525                      |
| 7. Time of return of pulse to standing (sec.).  | 0-120      | 58.89 $\pm$ 1.17  | 19.37 $\pm$ 0.85              | 32.9 $\pm$ 1.425                      |
| 8. Reclining systolic blood pressure (mm. Hg.). | 96-142     | 117.17 $\pm$ 0.51 | 8.5 $\pm$ 0.37                | 7.3 $\pm$ 0.3162                      |
| 9. Standing systolic blood pressure (mm. Hg.).  | 102-148    | 122.65 $\pm$ 0.53 | 8.85 $\pm$ 0.39               | 7.2 $\pm$ 0.312                       |
| 10. Difference between (9) and (8) ..           | -16 to +16 | +4.92 $\pm$ 0.35  | 5.72 $\pm$ 0.25               | 116.2 $\pm$ 5.033                     |
| 11. Schneider rating (points) ..                | 8-16       | 12.53 $\pm$ 0.13  | 2.13 $\pm$ 0.09               | 17.0 $\pm$ 0.736                      |

was  $17 \pm 0.736$  per cent. Its frequency distribution polygon is given in the figure.



Frequency distribution polygon for Schneider rating of Bombay medical students. The continuous line represents the selected healthy cases and the broken line the unselected cases.

Jackson (1927) obtained the following figures from observations on the medical students of Minnesota University, America: range of Schneider rating 0 to 18 with the mean at  $9.995 \pm 0.072$ ; standard deviation  $4.147 \pm 0.051$  and coefficient of variation  $41.47 \pm 0.59$  per cent. His age range was 18 to 39 with a mean of 20.0782 years. He however does not mention whether all the subjects had been free from any history of illness, whether at least two hours had been allowed between the test and the previous meal or refreshment, as also whether the subject had a good previous night's rest. These factors are bound to affect the rating.

Scott's (1921) mean figure for 410 candidates for the American Air Service was  $11.078 \pm 0.13$  with a range from -3 to +18. In his case too no mention has been made about the specific conditions under which the observations were recorded.

No Indian data are available in the literature for comparison with the figures given in the present paper, but compared with the American figures available and given above the mean rating of the Bombay medical students seems to be distinctly high probably because of the selection of the cases and conditions. An analysis of the records irrespective of such selection gave the following results. The frequency distribution is given in the figure.

Total number of subjects:—186.

Range of Schneider rating:— -1 to +16.

Mean:— $10.925 \pm 0.1773$ .

Standard deviation:— $3.585 \pm 0.1254$ .

Coefficient of variation, per cent:— $32.815 \pm 1.265$ .

Even when these figures are considered, it will be seen that the mean is higher than Jackson's and practically the same as Scott's. It may be concluded from this therefore that the circulatory—and incidentally the physical—efficiency of the average Bombay medical student as judged by this test does not seem to be in any way inferior to that of the average American medical student or Air Service recruit.

### Summary

(1) Data are presented of the rating of the circulatory efficiency—and physical efficiency—of 122 healthy male Bombay medical students as given by the Schneider test.

(2) It is concluded that as judged by this test the efficiency—both circulatory and physical—of the average Bombay medical student is in no way inferior to that of the average American medical student or Air Force recruit.

### Acknowledgments

I wish to thank Dr. G. A. Bhagwat for carrying out most of the observations on the students and the students for their co-operation.



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## PUBLIC HEALTH REPORTS

SEVENTY-THIRD ANNUAL REPORT OF THE  
 DIRECTOR OF PUBLIC HEALTH OF THE  
 UNITED PROVINCES FOR THE YEAR ENDING  
 31ST DECEMBER, 1940

**Cholera.**—The mortality in towns and rural areas during 1940 was 1,822 and 24,277, respectively, giving a death rate of 0.33 and 0.56. The death rate for the province as a whole was 0.54 against the quinquennial average of 0.50.

**Plague.**—During 1940 the mortality recorded in towns was 935 and in the rural areas it was 10,790 giving rates per mille of 0.17 and 0.25, respectively. The provincial death rate was 0.24 against the quinquennial average of 0.37. The Benares and Gorakhpur divisions recorded 11,060 deaths from plague, or nearly 94 per cent of the provincial mortality. Thus, it is in these two divisions and during the first quarter of the year that the epidemic was mostly prevalent. The infection in these eight districts continued practically throughout the year and the worst infected district was Jaunpur. The only districts other than those of Benares and Gorakhpur divisions which showed any appreciable infection were Fyzabad in the eastern part of the province and Saharanpur at the extreme west of the province.

**Smallpox.**—The mortality in towns and rural areas during 1940 was 3,765 and 12,096. The respective rates per mille of the population were 0.69 and 0.28. The mortality for the whole province worked out at 0.33 compared with 0.24 for the previous quinquennium.

**Malaria.**—There were 717,319 deaths recorded under malaria during 1940 as compared with 754,168 during the previous year, the mortality rates being respectively 14.82 and 15.58. Six hundred and ninety thousand, six hundred and ninety-two deaths were reported from the rural areas and 26,627 from the urban areas, the respective mortality rates being 16.07 and 4.89. The mortality recorded under malaria is greatly exaggerated and during 1940 formed as much as 68 per cent of the total mortality of the province. This is due to the system of reporting in the rural areas through the village *chowkidar* under which practically all cases in which fever is a symptom are relegated to this group.

**Enteric fever.**—There were 6,615 deaths from enteric fever during 1940, there being a decrease under this head from the previous year during which year there were 7,367 deaths. The urban and rural areas contributed 3,923 and 2,692 deaths with death rates of 0.72 and 0.06.

**Relapsing fever.**—The number of deaths reported under this head in 1940 was slightly lower than that in the previous year, the figures being 51 and 187, respectively. The urban and rural contributions were 29 and 22.

**Kala-azar.**—There were 83 deaths from kala-azar during 1940 against 81 during 1939. The respective urban and rural figures for 1940 were 25 and 58. Recent investigation into the prevalence of this disease disclosed that the districts of Benares and Gorakhpur have been recording the largest number of cases. Government have accordingly made arrangements for the treatment of these cases in five specially equipped centres.

**Cerebro-spinal meningitis.**—During 1940, deaths from this disease aggregated 76 against 89 of the preceding year. Sixty of these were reported from towns and 16 from rural districts.

**Dysentery and diarrhoea.**—The third quarter, followed closely by the second, recorded the largest number of deaths. The mortality under this group of causes decreased during 1940 compared to the previous year, the recorded figures being 16,238 and 17,962, respectively. The death rates for these years were 0.33 and 0.37.

**Pulmonary tuberculosis.**—In 1940 the total number of deaths recorded from pulmonary tuberculosis was 5,839 (5,263 in urban areas and 576 in rural areas), giving a death rate of 0.12 for the province as a whole. Mortality was most conspicuous in the towns of Cawnpore (4.50), Budaun (3.41) and Bijnor (3.66). The number of deaths recorded from tuberculosis of joints was 169 (63 from urban areas and 106 from rural areas). The number of deaths recorded from other tuberculous diseases was 2,010 (1,315 in urban areas and 695 in rural areas).

**Epidemic dropsy.**—During 1940, 55 deaths were reported from this disease against 29 in the preceding year. Of these 47 were reported from towns and 8 from rural districts. The largest number of deaths (15) was reported from Benares city. All the cases were treated either in the infectious diseases hospitals or at the fixed dispensaries. Necessary preventive measures were taken to check the spread of the disease. People were advised to exclude rice and mustard oil from their diet and to take plenty of green vegetables and fruits.

A new activity of the health unit in Partabgarh during the year was a re-vaccination campaign against smallpox. No less than 26,000 individuals, mostly in villages, were re-vaccinated and the operation was found no more difficult than the primary vaccination of children and infants.

In the reports of previous years have been given details of the work being done in the unit. It is not proposed to re-state them, except that the unit is being increasingly used for purposes of practical demonstration to workers in rural hygiene for investigation, experiment and research on public health problems and for epidemiological studies. Studies in the designing and construction of village sanitary conveniences are being continued and public preferences for the different types are being investigated.

Collaboration with the rural development organization is one of the most important duties of the district health staff. The department has issued orders in consultation with the rural development officer that co-operative efforts should be made to improve village sanitary conditions through persuasion or, if necessary, by prosecution of all delinquents.

## Current Topics

### Cholagogues and Drugs Acting on the Liver

By CHARLES NEWMAN, M.D., F.R.C.P.

(From the *Practitioner*, Vol. CXLV, November 1940, p. 361)

IN the old days, when 'a sluggish liver' was one of the most common of minor diagnoses, cholagogues loomed large in the pharmacopœia. After a period of neglect, there are signs of a return of interest in this group of drugs, an interest which reflects the modern tendency to attribute once again a good many indefinite disorders to deficient activity of the liver. Migraine, for instance, which used to be a 'bilious headache', is being more and more associated with failure of either the liver or the extra-hepatic biliary tract, ever since the French description of 'migraine biliaire' or 'duodénale' drew attention in this direction. And just as there seem to be allergic factors in the causation of migraine, so the rest of the possibly allergic disorders are beginning to be suspected of hepatic origin. Instances of a possible hepatic factor in diseases associated with or due to metabolic disorder might be multiplied indefinitely.

One of the first results of this renewed interest has been the separation of the 'chologogue' drugs into two groups:—(1) Drugs which cause an increased secretion of bile by the liver which are referred to as choleretics (on the analogy of 'diuretics') and (2) drugs which empty the gall-bladder, and so cause an increase of bile-flow into the intestine without necessarily increasing the amount secreted.

The second important modern change has been the understanding that in gall-stone formation (at any rate so far as concerns the common and clinically significant type, the multiple faceted stone), it is not so much an increase of cholesterol in the bile which does harm as a decrease in the bile-salt content. The bile salts keep the cholesterol in solution and, so long as it is kept in solution, it can cause no trouble. For this reason, the bile-salt content becomes the important factor. It is also important in the case of pure cholesterol stones, even if these are the result of an increase in the absolute quantity of cholesterol in the bile.

The third important principle is the appreciation of the fact that so-called biliary stasis, the failure of the gall-bladder to empty properly, is very rarely the result of weakness to be treated with stimulants of gall-bladder contraction, but is usually caused by reflex spasm which prevents the outflow of bile, and which is properly treated by continuous sedative therapy.

With these three principles in mind, it is possible to apply treatment much more rationally. Choleretics are indicated when there is reason to believe that the secretion of bile needs stimulation; bile salts should be given when it is desired to make the bile a better solvent for cholesterol (or, of course, a better digestive juice for the absorption of fats, sterols and fat-soluble vitamins); chologogues, in the strict sense, are rarely to be recommended but, to flush the biliary system or to relieve obstructions, sedative treatment is often very effective.

#### CHOLERETICS

What then are the genuine choleretic drugs? From the vast volume of work done on the subject and the enormous number of drugs investigated, one group stands out in efficiency: the *bile acids*. They are, without doubt, the most powerful choleretics available; they increase both the quantity secreted and also the bile-salt concentration of the bile. That this is a most fortunate combination of effects is obvious. There are many bile acids, natural and synthetic, from which choice may be made. *Taurocholic acid* and *glycocholic acid*, or preparations of bile, are effective, but not so good as *desoxycholic* or *dehydrocholic* acids. All, however, except *dehydrocholic acid*, increase the absorption of sterols from the intestine; indeed it is said to be as easy to increase the cholesterol content of an animal by administering bile acids as by feeding it on cholesterol. Therefore if an increased absorption of fats and sterols from the intestine is wanted, rather than a change in the composition of the bile, one of the two common bile acids, or *desoxycholic acid*, is indicated. If, on the other hand, choleresis without increased absorption of cholesterol is required, *dehydrocholic acid* should be chosen. Its sodium salt, often called by its trade name of 'decholin' is efficient, non-toxic, suitable for intravenous administration if necessary (it is commonly used for estimating the circulation time) and can be given conveniently in 10-grain doses by mouth after each meal.

Details about all the other reputed choleretics and chologogues can be found in Sobotka's 'Physiological Chemistry of the Bile', but one or two are worth mentioning here. Sodium salts are useless, but *potassium salts* are choleretics. Of the salts, the natural Carlsbad Sprudal salt is much the best. Increased water intake so far from increasing bile secretion seems to diminish it, and the argument by analogy from diuresis is quite unsound. A high protein diet increases bile secretion, carbohydrates do not. Alcohol and narcotics generally cause a decrease, but avertin increases bile secretion. *Salicylates* increase the volume of bile produced, but diminish its total solids.

The purges, including calomel, have little or no effect, but oil of *peppermint*, *dandelion* and *radish* are all choleretic.

#### CHOLAGOGUES

With regard to the emptying of the gall-bladder (pure chologogue action) in normal subjects, *magnesium sulphate*, *fats*, *eggs*, *vegetable oils*, and *vagal stimulant drugs* all have the effect of rapidly emptying the gall-bladder. Even the hypnotic suggestion of appropriate foods is effective, and the emotions control the activity of the gall-bladder to a considerable extent. Wittkower found that whereas fear and joy increased bile-flow, anger stopped it completely; it is well known that a meal eaten in anger is badly digested, and there are people with 'bilious tempers' who make themselves ill by being angry about their food. In patients with gall-bladder disease, stimulation of any kind usually has the effect of causing a complete spasm which arrests bile-flow (this, of course, is why such substances often precipitate an attack of gall-bladder pain). Proper sedative treatment with belladonna will, however, restore a more normal state, in which it is often beneficial to give, for example, a dose of fat last thing at night, or of magnesium sulphate in the morning. But it is worth while to remember that, unless the patient needs the extra nutrition, there is no need to stimulate the gall-bladder with fats; it empties itself perfectly well in a state of comparative inertia, provided spasm is eliminated.

#### SEDATIVE TREATMENT

The proper way to ensure that the gall-bladder empties in patients suffering from cholecystitis or gall-stones is to eliminate reflex spasm. If all the musculature of the extra-hepatic biliary tract is relaxed, bile can pour out from the liver under its own secretion pressure, and the gall-bladder itself will almost empty by virtue of its elastic fibres. Complete paralysis would, it is true, lead to a passive distension, but complete paralysis cannot be produced by medication. The best sedative is *tincture of belladonna*. The natural alkaloids in the tincture are better than atropine, which is racemic and not *lavorotatory*. The only essential in treatment with belladonna is to find out the correct dose for the particular patient. It is universally recognized that the proportional dose for small children is higher than for adults, but it is not so generally realized that 30 minims will not affect one adult so much as 10 minims will another. And yet the effect of belladonna is so definite that, as with digitalis, it is essential to ensure that it produces just the effect desired. Some patients need as much as 40 minims three times a day to produce an appreciable effect; a very few are extremely sensitive and suffer from mental effects with as little as 2 minims. Indeed, it is impossible to treat this latter class with belladonna or atropine at all.

The technique is first to give a test dose of 2 minims. This, in an atropine-sensitive patient, will produce a mild disorientation lasting only a short time but always recognized by the patient. If a larger dose is given, there is a risk of producing serious temporary mania. When it is proved that the patient is not sensitive, start with 10 minims and increase the dose by 2 minims on each occasion, so that the last dose on the third day will be 26 minims. When the limit is reached, there will be a complaint of dryness in the mouth, difficulty in reading, or flushing after the dose; these are the most common symptoms of poisoning, in that order. Do not tell the patient what to look out for; he will notice it, and complain in due course, and if forewarned will probably imagine symptoms prematurely. In fact, if there is any complaint on a dose of 10 minims, it is best to increase it at once to 15, to make sure, because if it is found to be genuine, it is likely that belladonna treatment is not really indicated. When the limit is reached, cut down the dose by 2 minims, or more, to a convenient figure, and rewrite the prescription to a conventional dose. It can then be given for as long as is necessary.

Belladonna is perfectly safe given in this way, even over long periods. It has no ill-effects, and is a drug of addiction only in the sense that patients are often unwilling to give up what has done them so much good, even when it is no longer necessary. It is usually best to give alkali at the same time: high acidity of the gastric contents contributes to biliary spasm, and gall-bladder dyspepsia is often helped by sodium bicarbonate. A good vehicle is tincture of rhubarb and water; it has a very comforting effect on the stomach in many diseases of the liver.

#### DRUGS ACTING ON THE LIVER CELLS

In cases of parenchymatous liver damage, cholagogues or choleretics have often been used in the past, but it has become understood that there is little point in trying to make a diseased liver secrete bile, and that when bile salts are not being excreted by the liver their administration may be actually deleterious.

#### THREE VALUABLE REMEDIES

For the treatment of the parenchymatous cells of the liver there are a certain number of drugs of known value, and a large number the efficacy of which is believed in with little or no scientific proof. Easily at the head of the list of valuable drugs comes *glucose*. This is admittedly a food, and dietetics fall outside the scope of this article, but it is more than a food to the liver; it is essential to the process of glycuronation, besides being the substance from which it derives its energy. However it exerts its remarkable power on the liver, one thing is certain: that the liver deprived of glycogen falls an easy prey to any toxic process, and is likely to be affected by the fatty change in the portal zone, associated with ketosis and enforced fat metabolism. It is better to give glucose as such than to rely on the patient's digestion of starchy or sweet foods. It is difficult to give too much because the patient refuses to take it when he becomes satiated; indeed the art of giving glucose is to present it in palatable forms. Sweets and barley-sugar may suffice for a short time, but their appeal soon wears off, and the familiar bottle of barley-sugar by the bedside, although academically reassuring, is of little value to the invalid. Glucose-sweetened lemonade is better, made from fresh lemons, but this should be changed for other fruit drinks before it becomes tiring. It is the lemon taste which the patient comes to dislike: this can be minimized by not putting peel in the lemonade. Grape-fruit juice or pineapple juice are both admirable substitutes; orange juice is not so good because it is sweet enough already, and it is important not to nauseate the patient with sweet things. It is wiser to fall short of the desired amount of glucose than to let a patient 'turn against' sweet drinks. If fruit flavours pall, glucose solution slightly acidulated with citric or tartaric acid, freely diluted with soda water, may be tried; the carbon dioxide largely paralyses taste. Glucose should be given in any case of liver disease in which the polygonal cells are, or are likely to be, affected, and the amount required should be directly proportional to the risk of liver necrosis ('liver atrophy'). The risk is the indication, not the fact. Necrosis of the liver is too dangerous to be awaited, it should be prevented. This is not so difficult as it sounds, if it is remembered that almost all diseases of liver cells resemble 'delayed chloroform poisoning', in that the clinical evidence of liver necrosis follows the actual damage, after an interval; the liver is poisoned first and the patient is poisoned subsequently by the failure of the liver. Even catarrhal jaundice is a 'delayed' liver disease; the damage is done during the prodromal period before the jaundice appears. Give glucose in any case in which the liver is likely, on grounds of clinical experience, to suffer, not forgetting such possible causes as passive venous congestion in heart failure and severe cases of Graves' disease or pneumonia.

Next to glucose comes *calcium*. There is experimental as well as clinical evidence for this. There are two ways of increasing the amount of calcium available for

the liver; one is to give it in a form which will be absorbed, the other to mobilize it from the bones by giving acids. Calcium lactate is not sufficiently absorbed to be the perfect form to administer, and acidification is better avoided because the liver works best with a plentiful supply of alkalis. There are two methods of administration: the oral and the parenteral. The oral suffices for the least urgent cases, but the parenteral is the method of choice in emergencies, and has the advantage that it is known that the calcium is arriving where it is needed and in what amount. Orally, calcium sodium lactate is certainly efficient. It is best given in doses of 20 to 60 grains three times a day. Calcium chloride is a gastric irritant, but small doses of 1 to 2 grains in weak solution ( $\frac{1}{2}$  to 1 per cent) are usually innocuous. Other forms of calcium may be effective when given by the mouth, but the above are of known efficacy. By injection, calcium chloride, 1 per cent in distilled water, may be given with care. It is dangerous to inject it rapidly, as it stops the heart, and 20 minutes should be taken to give the dose of 100 c.c.m. Calcium gluconate or lavulinate, which may be obtained ready for injection in ampoules (10 c.c.m.), is better, but even this is not fool-proof; it is easy to stop the heart by injecting calcium, even in this form, if it is done rapidly. A simple safety device is to use a fine hypodermic needle for the intravenous injection. It seems absurd ever to use anything else, except for blood transfusion, but there is a common prejudice in favour of 'vein puncture needles' for anything to do with veins. Never inject calcium into anything but a vein: it can cause unpleasant necrosis of tissue and, even if the practitioner cannot see the necrosis of an intramuscular injection, the victim can feel it. If calcium is being given by injection, one dose a day is enough.

The other drug which seems to do good in diseases of the liver cells is *sodium bicarbonate*. Any alkali will do, but this is the natural one and the easiest to obtain. The evidence for its value is not nearly so good as it is for glucose and calcium, but there seems to be at least clinical evidence in its favour. There is no need to make the urine alkaline; 10 grains, three times a day, is enough.

#### Examination of the Heart for Military Service

By F. M. SMITH, M.D.

(From the *Journal of the American Medical Association*, Vol. CXVII, 2nd August, 1941, p. 329)

THE determination of the fitness of the heart for military service presents problems that are seldom encountered in civil practice. Thus it is frequently necessary for the examiner to rely on signs alone, and these may be of questionable significance. Tachycardia, systolic murmurs and slight elevation in the blood pressure are commonly observed. Certain persons with tachycardia give poor response to exercise. This may have resulted from sedentary life or from chronic infection, or perhaps the history may disclose that it has been present since childhood.

Acceleration of the cardiac rate is often the first and may be the only feature that attracts the attention of the examining physician. This is usually due to excitement incident to the examination and thus promptly subsides as the subject becomes relaxed. If, however, it persists, a careful search for a cause is demanded. Tachycardia may be caused by various conditions but is more commonly due to infection or irritable heart.

The response of the cardiac rate to a given amount of exercise does not necessarily provide information concerning the efficiency of the heart, nor does it determine the presence or absence of disease. It is of value, however, in estimating the general physical fitness. If the rate becomes excessive and the time required for it to return to the original level exceeds two minutes, the response is not satisfactory. This is often due to poor

physical condition from various causes and not to the heart alone. Thus the response of persons with chronic valvular heart disease may be good, whereas that of one who has led a sedentary life or has an infection may be poor. In questionable cases the history with reference to the participation in physical activities and the response provides much better means of estimating the possibilities of the individual, provided he is free from disease. If it is found that he has been capable of withstanding strenuous exercise in the past, there is good possibility that he may qualify for military service.

The work of the cardiovascular boards during the first World War was chiefly concerned with the examination of men presenting varying degrees of irritable heart, commonly designated as neurocirculatory asthenia, or effort syndrome. The reduced tolerance to exercise is the most characteristic feature of this disorder. Thus on slight or moderate exercise the subject experiences shortness of breath, palpitation of the heart and fatigue comparable to that normally produced by the more strenuous and sustained form of physical effort. Others in addition may have various other symptoms, such as precordial distress, giddiness or perhaps headache. All have unstable vasomotor systems, perspire freely and present cyanosis of the hands when the latter are in the dependent position. Some give a history of having had reduced tolerance to exercise since childhood. In another group the condition was associated with various chronic infections, particularly pulmonary tuberculosis, or followed severe acute infection, such as influenzal pneumonia. Finally in a number the disorder developed while engaged in active warfare. In this connection the series of cases studied by Lewis are of particular interest. Lewis found that the majority of his patients were recruited from sedentary or light occupations. Moreover, the history disclosed that a large percentage of this group had the disorder in civil life and that many of these had been forced to adopt sedentary occupations. It is apparent from the results of this analysis that it is commonly possible to discover or suspect this condition before the subject is inducted into military service.

Alterations in the character of the heart sounds are seldom of much help in the diagnosis of heart disease. Accentuation of the first sound at the apex may be a prominent feature in mitral stenosis. However, it is generally associated with presystolic murmur. In the early stages of mitral stenosis the murmur is frequently confined to a small area and may not be elicited except immediately following exercise, particularly with the subject in the recumbent position and turned toward the left side. Intensification of the second pulmonic sound is present in mitral stenosis, and a loud aortic second sound results from hypertension. Alteration in the character of the latter, especially tympanitic quality, is occasionally the first feature to suggest syphilitic aortitis and the possibility of a diastolic murmur. This murmur may escape detection unless a careful search is made. It is more easily heard by direct auscultation when the subject is in the sitting posture and while he is holding his breath after complete exhalation.

Systolic murmurs over the apex and the pulmonary area are common in men of the draft age, especially in those with tachycardia and slight elevation in the blood pressure. These murmurs are usually soft blowing in character, seldom transmitted to any significant extent, and frequently are altered by posture and respiration. Those of the cardiopulmonary variety are loudest at the end of inspiration and may entirely disappear at the end of forced expiration. There are many instances in which a final decision is dependent on additional information. This is especially true if the murmur is rather prominent and is constantly heard when the subject is in the standing and recumbent positions. A harsh murmur at the apex is invariably indicative of structural alterations in the mitral valve and it is generally possible to demonstrate a presystolic murmur. In many instances, however, the history is negative for rheumatic fever. Levine has emphasized the importance of grading murmurs with reference to their intensity and states that those of grade 2 intensity and above are generally

due to organic disease. He further points out that a systolic murmur has greater significance if the heart rate is slow, the blood pressure is low and there is no anaemia. It is, of course, well to bear in mind that a faint systolic murmur at the apex may be on an organic basis; consequently the correct evaluation of this sign is of great importance. The history of rheumatic fever, a diastolic murmur or increase in the size of the heart settles the issue.

A harsh murmur with the greatest intensity over the pulmonic area in the third and fourth left interspace, particularly when accompanied by a thrill, is generally due to one or more congenital anomalies. Further confirmation is obtained by the size and shape of the heart and by the electrocardiogram, if there is a conspicuous right axis deviation. The history is usually negative for rheumatic fever but may disclose that a murmur has been present since infancy.

The size of the heart is often the deciding factor in determining the presence or absence of heart disease. Ordinarily it is possible to locate, with a fair degree of accuracy, the left border of the heart by percussion. This is best accomplished with the subject in the sitting position and by direct percussion. If there is doubt regarding the results, they may be checked by the location of the apex impulse. In the normal subject the apex impulse is limited to a relatively small area and usually located in the fifth interspace, well within the nipple line. The outermost point at which the examining finger is raised by the heart represents the left border at this level and generally checks with the results obtained by percussion. The location of the apex beat varies with the type of chest. Thus in those with short thick chests it is at a high level and may extend to the nipple line. In general, however, if the apex impulse extends beyond this point it is indicative of cardiac enlargement. An unduly prominent apex beat or one occupying a relatively large area is ordinarily associated with enlargement of the heart. In persons with a thin chest and a hyperactive heart the impulse may be rather diffuse. This, however, disappears with the recession of the cardiac rate.

Frequently the blood pressure is slightly elevated with tachycardia but usually returns to the normal with the disappearance of the latter. If under these circumstances and after repeated determinations the systolic pressure is 150 or more and diastolic is 90 or more mm. of mercury it is indicative of hypertension. Further investigation may demonstrate the presence of albumin and casts in the urine or, in rare instances, coarctation of the aorta. In the vast majority of cases no cause is found and the condition is listed as essential hypertension.

Special laboratory procedures, such as the use of the roentgen ray and the electrocardiogram, are seldom necessary in this type of examination. Occasionally a roentgenogram is advisable to check the size and shape of the heart. In rare instances it may be difficult to differentiate between premature beats and auricular fibrillation by auscultation, and thus an electrocardiogram is indicated. Auricular fibrillation, however, is generally associated with obvious structural changes in the heart. Sinus tachycardia may suggest paroxysmal tachycardia or perhaps auricular flutter. The fact that the cardiac rate in the former subsides with relaxation dispels any doubt about the situation. Finally the taking of an electrocardiogram may be justified, if the heart rate is unusually slow, in order to rule out the possibility of auriculoventricular block.

#### SUMMARY

The determination of the fitness of the cardiovascular system for military service may be difficult because it is frequently necessary for the examiner to rely on signs alone and often these are of questionable significance. Tachycardia, systolic murmurs, slight elevation in blood pressure or a combination of these are the features that usually attract the attention of the examining physician. These are commonly of no importance, but they demand careful investigation. That tachycardia may lead to the disclosure of infection, particularly pulmonary tuberculosis. Moreover, in certain of the remaining, the

response to exercise may be poor and further study may reveal the presence of an effort syndrome. Systolic murmurs should always be carefully evaluated. The history may give important, or even decisive, information. Finally, a decision regarding slight elevation of the blood pressure is not justified until the cardiac rate has receded to the normal level.

## Dyspepsia

By G. EVANS, M.D., F.R.C.P.

(From the *Medical Press and Circular*, Vol. CCIII, 10th April, 1940, p. 303)

THE term dyspepsia is commonly used to describe symptoms due to functional disturbance of the stomach without gross structural change. This definition excludes organic diseases of the stomach, such as ulceration, new growth, hour-glass stomach and pyloric obstruction, but in clinical practice it includes some forms of gastritis and duodenitis. It also excludes symptoms primarily due to intestinal disorder, although it is recognized that there is some justification for using the term 'intestinal dyspepsia' for disturbances of bowel function. Thus Sir Arthur Hurst's term for intestinal disorder due to a failure of carbohydrate digestion—intestinal carbohydrate dyspepsia—is generally accepted. Even with these limitations in the definition of dyspepsia, the subject is one of vast extent. As Sir Walter Langdon Brown has said, the stomach is more often sinned against than sinning. Any loss of health may upset the stomach. In fact, the complete diagnosis of dyspepsia may involve the whole gamut of medicine.

### DIAGNOSIS

The diagnosis is made in successive stages. The diagnosis at one stage must be carefully made before the next stage is disposed of. The several stages must be kept distinct in the examiner's mind in order that whenever a case is reviewed each stage may be checked up and reconsidered separately.

*Stage 1: Symptomatic diagnosis.*—The patient reports symptoms of dyspepsia, generally in terms of indigestion. Is his diagnosis correct? A detailed account of his sensations is the first step in diagnosis. This account is a record of actual sensations, their quality, intensity, location and radiation: their onset, duration and relief: the conditions that seem to determine them, and the conditions which give relief, together with associated sensations arising from other parts of the body. These sensations form the *present symptom picture*. Its description by the patient unburdens his mind. Its reception by the examiner relieves the patient of the need to keep in mind many things he has been trying to remember to tell. His attitude changes when he has finished describing his symptoms in every detail. He came for help and now he is ready to help. Inquiry is next made as to the onset of the symptoms. The *initial symptom picture* is likely to be clearer and more definite. It is uncomplicated by subsequent developments. The patient only remembers the salient features of his first sensations and, especially if he was symptom-free before the onset of his dyspepsia, the initial sensations will have made a very clear impression on his mind. Finally, the intervening period is filled in. The initial, intervening and present symptom pictures together make the *complete symptom picture*.

In taking this history step by step inquiry proceeds simultaneously in other directions (along which the patient is apt to digress all the time) with the object of linking up the symptom picture with various phases of physical and emotional activity. A definite time relation of the symptoms with gastric activity establishes the anatomic diagnosis, and it serves to make the differential diagnosis between dyspepsia and intestinal dyspepsia. The relation of the patient's symptoms to changes in his environment, internal and external, physical and mental or emotional throws light on their possible causation.

The importance of elucidating and recording the *complete clinical picture* in all its detail cannot be over-emphasized. If the diagnosis of dyspepsia is wrongly made the examiner is likely to conduct the rest of his examination on the wrong basis. For instance, a patient reports a little sensation of fullness after food high up in the abdomen. The quality of the sensation, its location and relation to food, may lead the examiner to diagnose dyspepsia. At a later date, when the present symptom picture makes the diagnosis obvious, a review of the initial symptom picture may reveal the fact that the earliest sensation was actually of something sticking: its location was under the xiphisternum, and not high epigastric: it was felt actually during the act of deglutition, and not after the food was completely swallowed. In such a case the diagnosis of carcinoma of the gullet is delayed weeks or even months. The usual short cut to diagnosis of gastric disorder, a barium meal x-ray examination, may seem to confirm the diagnosis of dyspepsia by its negative finding, and this, of course, is due to the original wrong diagnosis having led to the examination of the wrong organ.

*Stage 2: Differential diagnosis between functional and organic disease.* (a) *Organic disease of the stomach.*—The diagnosis of dyspepsia depends largely on the exclusion of organic disease, and the possibility of its location in the stomach comes up for first consideration. Organic gastric disease must be assumed if the patient complains of actual pain having a gastric reference. In fact, it is the best practice to assume that all abdominal pain has an organic basis until the assumption is abundantly disproved. The symptom picture of organic gastric disease is more definite than that of dyspepsia. The symptoms themselves tend to be more sharply defined, and more regular and persistent in making their appearance. The picture of peptic ulceration, at least in its initial symptom picture, the sequence of food and pain, the alternation of remission and relapse, are too well known to require description. The peculiar loss of appetite, at a later stage, the nausea and constant slight pain, are characteristic of neoplasm. The character of the vomiting and the vomitus makes the diagnosis of pyloric obstruction a simple matter when it is well established. Hæmatemesis and melæna have obvious significance. But as medicine is now practised, we have learnt to rely on no single method of investigation. *Organic disease must be looked for to be found.* The symptom picture may be that of dyspepsia. Clinical examination may be negative, even that slight sense of localized resistance on palpation of the upper abdomen (so suggestive of underlying organic disease) may be absent: nevertheless, further examination of the digestive tract must be made if there is any doubt as to the diagnosis, or if the symptoms persist in spite of treatment. A blood count, examination of the faeces for occult blood (after proper preparation of the patient and with due regard to the many fallacies), and a barium meal x-ray examination of the œsophagus, stomach and duodenum, are the first additional examinations to be made. In some cases, such as suspected neoplasm of the stomach, pernicious anæmia and essential hypochromic anæmia, a fractional test meal may be advisable.

(b) *Reflex dyspepsia.*—First consideration is given to the digestive tract. In defining the complete symptom picture it may become recognized that there are two or more symptom pictures in the patient's story. There may, for instance, be an irregular dyspepsia characterized by occasional loss of appetite or distaste for certain foods, fullness after meals and flatulence upwards, symptoms suggestive of gall bladder dyspepsia. In addition, there may be an account of symptoms of biliary colic with or without jaundice. And in the same patient there may be a third symptom picture due to dyschezia, congenital or acquired. Each one of these symptom pictures carries with it its several differential diagnoses. Biliary colic, in a doubtful case, for instance, turns the examiner's mind to the possibilities of peptic ulcer, appendicitis, renal colic (right-sided), hiatus hernia and allergic reaction to some



food. Or, if the symptom picture of dyspepsia is complicated by the symptom picture of appendicitis, however indefinite it may be, the varied differential diagnosis of right iliac fossa pain comes up for review. The differential diagnosis of reflex dyspepsia extends, of course, to organic disease of every abdominal and pelvic organ. It extends especially to every organ supplied by the vagus nerve. We know dyspepsia as the common presenting symptom picture of pulmonary tuberculosis, as well as a common complication of heart disease. Disease of the nervous system, whether functional or organic, may be responsible for symptoms of dyspepsia. Visceral crisis of tabes dorsalis, and the vomiting due to increased intracranial pressure, do not, of course, come within the picture of dyspepsia, but these same diseases may disturb gastric function in minor ways at an early stage in their evolution, and organic disease of the nervous system must be excluded in making the diagnosis of dyspepsia.

It follows from this that the patient's history, after the complete symptom picture is completed, and associated symptoms have been described, must include a statement under past history as to whether or not he or she has suffered from jaundice, appendicitis, dysentery, colitis and piles, or has been to the tropics. This series of questions is generally sufficient to direct the patient's attention to other possible abdominal complaints. It should also include inquiry as to past respiratory illness, such as bronchitis, influenza, pneumonia, and pleurisy. Family history, too, may throw light on the diagnosis, because some forms of dyspepsia and some of its causes tend to run in families.

The clinical examination is the routine overhaul which establishes integrity of the central nervous system, the heart and lungs. It must always include examination of the urine, estimation of the blood pressure and record of body weight. Endocrine disorder is to be looked for. A blood count is one of the first special examinations to be made. With regard to abdominal examination, a detailed routine should be followed, beginning with inspection, and including examination of the hernial orifices and the linea alba: careful palpation of the gall bladder, appendix and renal regions: careful palpation of the gastric and duodenal regions: a rectal examination should be made in all cases, or if omitted the fact should be recorded.

*Stage 3: Aetiological diagnosis.*—The line of investigation conducted to establish the aetiology of dyspepsia proceeds from a consideration of the present to the past, and from a survey of simpler factors to those more difficult to assess.

(a) *Digestive function as a whole.*—The stomach is just a part of the whole digestive tract, and disorder of one part of this tract often refers its symptoms to another part of the tract, and generally in a proximal direction. It follows, therefore, that intestinal dysfunction is often registered in symptoms of dyspepsia. Inquiry into bowel function is therefore essential. This inquiry especially concerns defaecation, and as to whether the stool evacuated is normal, and whether or not it is accompanied by a sense of completion: whether or not laxatives are taken and, if so, what kind, what quantity, how often, and at what time of day. Apart from the bowel dysfunction that the habitual use of laxatives is liable to cause, laxatives may themselves cause dyspepsia.

(b) *Dietetic factors.*—Under this heading is included a consideration of everything that reaches the stomach via the gullet. Food that is not good, that is in itself indigestible or badly cooked, is a common cause of dyspepsia: or when the food is good in all respects indigestion may be due to excessive intake. Foods more likely to tax gastric digestion and upset the stomach are fats, especially fat that has been over-heated as in frying, and starch cooked with fat. A general rule, therefore, in the treatment of gastric dyspepsia is restricted fat intake. Another cause of dyspepsia is insufficient mastication due to hurried eating or deficient masticating surface. Food idiosyncrasies have also to be borne in mind, and in taking history inquiry is always made, as to a past history or family history of allergic disease, and possible food idiosyncrasy. Among

obvious gastric irritants are excessive use of condiments, excessive intake of alcohol, tea, coffee and iced drinks. These factors are well known, but it is not so well appreciated how many people have an idiosyncrasy to certain forms of alcohol, and that even one glass of sherry or one whisky-and-soda a day may upset the digestion of some people who happen to be intolerant of it. In other cases the fault lies in the opportunity provided for the stomach to do its work. Thus dyspepsia may be due, for instance, to breakfast being eaten too soon after getting up, or to the patient starting the day's activity too hurriedly after finishing a meal.

(c) *Gastric tone and motility.*—More difficult factors to assess are those which concern emotional tone and exhaustion states. Physical fatigue is a direct cause of dyspepsia, as when a man eats his evening meal too soon after return home, exhausted by a day's work. Emotional tension and strain are equally potent causes of dyspepsia. When these factors are occasional their connection with gastric disturbance is easily recognized, but in some patients they are habitual, and the patient is unaware of his nervous state or, if conscious of it, may regard it as natural. Another large group of cases have a psycho-neurotic background.

(d) *System function as a whole.*—This is too large a subject to be dealt with adequately, but some brief reference must be made to it. Any considerable or persistent disorder of function of any of the body systems may be a cause of dyspepsia. The importance of emotional states and psycho-neurotic factors has been referred to in the previous paragraph. Other functions of the central nervous system, especially sleep, and the function of the special senses may be aetiological factors. Of equal importance is the functional and structural integrity of the locomotor system. Thus in some cases causes of dyspepsia may be found in bad stance and posture or under-developed respiratory movement. The condition of the feet, such as hallux valgus, pes planus, corns and bunions causing symptoms, spinal deformities, congenital and acquired, and loss of tone in the muscles of the abdominal wall, are all factors which may be of importance in determining dyspepsia, or maintaining it when established for some other reason.

#### TREATMENT

The treatment of dyspepsia is to some extent obvious from the foregoing analysis of its causation. In general terms, the first line in treatment is to deal with organic disease and treat the dyspepsia symptomatically. It should be remembered, however, that when organic disease and dyspepsia are present in the same body, the former may not be the cause of the latter. Care must be taken by a review of the case to establish, if possible, a causal connection. Dyspepsia may, in fact, persist after removal of a chronic appendix, or after the removal of an abnormal gall bladder. In doubtful cases it is often advisable before embarking on surgical treatment to correct functional disturbance, and restore so far as is possible every organ to normal working. This applies especially to intestinal activity and defaecation. At the same time the patient is advised as to alteration of such habits of life, and eating and drinking as may be causing or aggravating his symptoms. By detailed treatment on these lines, if successful, it is surprising how often emotional strain and nervous exhaustion are relieved, and even a psycho-neurotic basis may be resolved. In other cases, where the psycho-neurosis is the determining factor, the doctor may have to decide between a surgical and psycho-therapeutic approach. It is not uncommon for the patient to make the decision and himself to ask, for instance, for the removal of a suspected appendix. Whether or not the organ in question is the cause of the dyspepsia, its removal may have considerable psycho-therapeutic value. It is satisfactory to the patient to feel that a diseased appendix and not his 'nerves' is the cause of his dyspepsia. He may feel to blame for a functional disturbance: he certainly feels it no fault of his that he has organic disease. He gets rest in bed and a pleasant convalescence, and for the

time that he is under surgical care he is in an atmosphere which is most favourable to emotional calm and recovery of self-confidence.

### The Bacteriophage:

#### Its Nature and its Therapeutic Use

By A. P. KRUEGER, M.D.

and

E. J. SCRIBNER, Ph.D.

(Abstracted from the *Journal of the American Medical Association*, Vol. CXVI, 17th May, 1941, p. 2269)

1. THE nature of bacteriophage is no longer in question. It is a protein of high molecular weight and appears to be formed from a precursor originating within the bacterium. There is evidence that the precursor likewise is a protein and that it is synthesized by the cell during a phase of accelerated metabolic activity. The process by which the inactive precursor is transformed into active phage is catalyzed by phage; i.e., the primary reaction is:

Inactive phage precursor + phage  $\longrightarrow$  phage.

2. For all practical purposes phage production proceeds at a significant rate only when the environment permits bacterial growth and concomitant synthesis of precursor. The most prominent phase of bacteriophagy, massive dissolution of the susceptible bacteria, takes place when enough phage has accumulated to raise the phage/bacteria ratio to the critical lytic threshold.

While phage action *in vitro* is spectacularly effective in bringing about bacterial destruction, bacteriophagy *in vivo* operates on a much less efficient scale and plays a negligible part in the clinical application of phage. There is no substantial evidence that the spontaneous development of phage in the infected host has any bearing on the process of recovery.

Four alternative mechanisms by means of which lysates conceivably may exert a beneficial therapeutic effect include:

(a) Phage-induced dissociation of less virulent variants from the original pathogenic invader.

(b) Augmentation of phagocytic efficiency through phage action.

(c) Stimulation of specific antibacterial immunity in the host by antigenic fractions of lysed organisms.

(d) Activation of specific or non-specific immune mechanisms of the host by entirely non-specific elements in the lysate.

The first of these is of little more than possible significance but the last three are unquestionably important and completely outweigh the long over-stressed theory that lysis of bacteria *in vivo* is responsible for the clinical successes of phage therapy.

3. The reported data on the use of phage in various diseases caused by bacteria are for the most part insufficient to establish phage therapy as a method of choice. Only rarely have these studies included an adequate bacteriologic background, control groups or careful comparison with accepted therapeutic procedures. There is evidence, however, that a properly prepared lysate can serve satisfactorily as:

(a) A vaccine for the treatment of certain diseases, e.g., some types of staphylococcal lesions.

(b) An agent for the induction of non-specific protein shock in syndromes in which at times such shock may be used to good purpose, e.g., typhoid.

(c) A measure for enhancing the general resistance of an infected area when applied topically. This depends on its non-specific action in mobilizing macrophages and microphages.

It is equally evident that phage solutions possess no measurable degree of superiority over well-known and accepted preparations employed for the same purposes; for example, bacterial vaccine and toxoid in carbuncles and furunculosis or typhoid vaccine in non-specific protein shock therapy. Modern chemotherapeutic approaches to the treatment of a variety of conditions for which phage has been recommended (cystitis,

pyelitis, gonorrhoea, certain bacteremias) offer more chances of success than does phage.

While it has become almost axiomatic to state that the use of phage is entirely innocuous, we have not found this to be the case. The literature provides numerous accounts of reactions ranging from mild to severe following the injection, local application or ingestion of phage, and animal experimental work has shown that lysates may contain enough soluble toxin or Reynal's spreading factor to be actually dangerous.

4. Although it is admittedly very difficult to arrive at definite conclusions regarding the efficacy of any therapeutic agent used for the treatment of certain diseases, the accumulated clinical data on phage are in some instances highly suggestive and warrant the continuation of further studies under thoroughly controlled conditions. This is particularly true of cholera.

### Gonorrhoeal Urethritis in the Male Treatment with Sulphapyridine and Sulphathiazole

By C. A. W. UHLE, M.D.

L. W. LATOWSKY, M.D.

and

F. KNIGHT, M.D.

(Abstracted from the *Journal of the American Medical Association*, Vol. CXVII, 26th July, 1941, p. 247)

1. SULPHAPYRIDINE and sulphathiazole are equally efficacious in the treatment of gonorrhoeal urethritis in the male.

2. Toxicity is manifested less with sulphathiazole than with sulphapyridine.

3. Sulphathiazole is the drug of choice in the treatment of gonorrhoea.

4. It would seem that a combination of oral chemotherapy and local treatment is preferable.

5. Chemotherapy has altered our conceptions of the provocative tests.

6. The value of the culture over the smear should be stressed in pronouncing a patient cured.

7. A social menace is created by the asymptomatic carrier.

### Gonococcal Conjunctivitis:

#### A Comparison of Sulphanilamide, Sulphapyridine and Sulphathiazole in the Treatment of One Hundred and Twenty Cases

By P. M. LEWIS, M.D.

(Abstracted from the *Journal of the American Medical Association*, Vol. CXVII, 26th July, 1941, p. 250)

ONE hundred and twenty patients with gonococcal conjunctivitis were treated with the sulphonamides.

Toxic reactions, with the exception of one case early in the series, were practically negligible. Nausea occurred frequently, especially with administration of sulphapyridine. Slight cyanosis was rather common. In very few cases were there any significant changes in the blood cell counts or in the haemoglobin.

There seems to be no contra-indication to the systemic use of the sulphonamides except a definite history of previous intolerance to the drugs.

Sulphapyridine is amazingly effective in the treatment of gonococcal infections of the eye. Sulphathiazole is apparently somewhat less effective. Both are definitely superior to sulphanilamide. A cure may be expected within three days, as a rule, from the time sulphapyridine treatment is begun.

My limited experience with local treatment by the sulphonamides leads me to the conclusion that it does not compare favourably with the internal use of the drugs. Recently a 5 per cent solution of sodium



sulphathiazole instilled locally every two hours has been tried along with the usual dose of sulphathiazole internally. Apparently it is of definite value.

Every patient with gonococcal conjunctivitis should immediately be given adequate systemic treatment with sulphapyridine or sulphathiazole.

## Reviews

**THE BRITISH ENCYCLOPÆDIA OF MEDICAL PRACTICE INCLUDING MEDICINE, SURGERY, OBSTETRICS, GYNÆCOLOGY AND OTHER SPECIAL SUBJECTS. SURVEYS AND ABSTRACTS. 1940.** Edited by Sir Humphry Rolleston, Bt., G.C.V.O., K.C.B., M.D., D.Sc., D.C.L., LL.D. 1941. Butterworth and Company (Publishers), Limited, Bell Yard, Temple Bar, London. Pp. xiii plus 596 plus 50. Illustrated. Obtainable from Messrs. Butterworth and Company (India), Ltd., Bombay

THE promise that the *British Encyclopædia of Medical Practice* would be maintained as a living contribution to medical science by the annual publication of supplementary volumes was given in peace time, and nobody could have criticized the editors and publishers had they failed to redeem this promise. Yet they have, and what is more the volumes have been safely delivered in this country.

These supplementary volumes are two, one of reviews and abstracts, the other a cumulative supplement. The latter replaces the previous cumulative supplement and the previous 170 pages have now increased to 283; the former makes a permanent addition to the encyclopædia, of which there are now 15 volumes, the original 12, the general index, and 2 annual volumes of reviews and abstracts. This last volume is infinitely better than its predecessor on which we commented that the writers seemed a little uncertain what was expected of them.

The first part consists of 16 critical surveys of medicine, surgery, gynæcology and the specialties under separate headings. The writers' authority is usually unimpeachable but the subjects have been dealt with so summarily that the value of the reviews is often impaired, and we feel that the editor might be a little more generous in his allotment of space. There is one article, excellent though it is, which seems to be entirely out of place, as it deals with a specific disease, namely, tick-bite fever.

The second part is on 'recent advances in drug therapy'. This means, vitamins—4 pages, sex hormones, almost entirely synthetic—1 page, sulphonamide compounds—2½ pages, and the rest—2 pages. This reflects modern trends.

The third part of the book is devoted to abstracts of medical literature arranged alphabetically and more or less under the headings of the original articles in the *British Encyclopædia of Medical Practice*. These are well selected, and accurately and concisely presented.

The publishers and editors have more than kept their promise of keeping this book alive, and they have done it under what must have been very difficult circumstances.

**SURGERY OF MODERN WARFARE. PART V.—** Edited by Hamilton Bailey, F.R.C.S. Section IX (continued). Wounds of the Face and Neck including those of the Special Senses. Section X:—Wounds of the Central Nervous System and its coverings. Section XI:—Surgical Diseases encountered in Subtropical Countries. Section XII:—Administration. Section XIII:—Appendix. 1941. Complete in five parts. E. and S. Livingstone, Edinburgh. Pp. from 641 to 876. Illustrated. Price, 17s. 6d. Postage, 7d.

THIS very important war book has now reached its last part. Section IX, on wounds of the face and neck, is concluded. Section X is on wounds of the central

nervous system and its coverings. It is an important section consisting of four chapters, including one on the management of the bladder in spinal injuries.

Section XI is a most surprising one to encounter in a book on war surgery. It is entitled 'Surgical Diseases encountered in Subtropical Countries'. We cannot entirely blame the author of the section, except that one assumes he could have refused the invitation to write on subjects that he obviously knows little about and which haven't the slightest claim to being considered surgical diseases. All went well at first, amœbic hepatitis and liver abscess are certainly the surgeon's field, and there is a distinct surgical aspect to filariasis. Bacillary dysentery, when it becomes chronic ulcerative colitis, may also come within the surgeon's scope, but its surgical treatment is well within the bounds of non-tropical surgery and it isn't war surgery in any sense. Schistosomiasis also has its surgical aspect but only the medical treatment is described and it is recommended that the surgical treatment 'is conducted on general principles'. Oriental sore again can be treated surgically but this treatment is not described though it is mentioned. Then comes kala-azar, with a most garbled and inaccurate version of the disease but without any indication of why it is supposed to come within the purview of the surgeon; this paragraph is illustrated by a photograph of a case of Egyptian splenomegaly! The section ends with a short description of yaws, and, believe it or not, cholera.

The next section is labelled 'Administration'. It is an essentially practical one. The chapters are on the stretcher case, wounds in naval action, the organization of a field ambulance, the transportation of the wounded, and the organization of a first-aid post.

Finally comes the appendix. This has a dual function—to give new information that has only come to hand since the earlier parts of book were completed so that it could not be included in its proper place, and to correct existing sections, because the weight of opinion is against the statements made, or because subsequent experience has necessitated their modification or contradiction.

This unique war book has now been completed and, although much that has been included will need more correction and modification than even this last part has provided, it is better to have a book of this kind, with all its defects, now rather than after this war when we hope that the medical profession will have little further use for at least 90 per cent of it.

**THE SCIENCE AND PRACTICE OF SURGERY.—**By W. H. C. Romanis, M.A., M.B., M.Ch. (Cantab.), F.R.C.S. (Eng.), F.R.S. (Edin.), and Philip H. Mitchiner, C.B.E., T.D., M.D., M.S. (Lond.), F.R.C.S. (Eng.). Seventh Edition. 1941. Volume I:—General Surgery. Volume II:—Regional Surgery. J. and A. Churchill, Limited, London. Volume I:—Pp. x plus 819 plus 76 (Index). Illustrated. Volume II:—Pp. x plus 981 plus 76 (Index). Illustrated. Price, 15s. each volume

*The Science and Practice of Surgery* is a relative new-comer among the standard textbooks of surgery in England, as its first edition appeared in 1927. The reviewer, having used the first edition in his student days, can remember that it was received with enthusiasm not unmixed with criticism. It is satisfactory, therefore, to renew acquaintance with the book in its present form and to see how much improvement has been achieved since fourteen years ago.

The book is in two volumes, the first on general surgery, and the second on regional surgery. The first volume describes, in the customary manner, general surgical procedures, surgical pathology, injuries and orthopaedics. It winds up with chapters on x-rays, anaesthesia, and an appendix on war surgery. A feature of this edition is the curtailment of the section on bacteriology to mere five pages. There are points both for as well as against the inclusion of bacteriology in an elementary surgical textbook. Since the first volume is considerably smaller than the second, perhaps it will be found possible to do more justice to this subject in a future edition.

The chapter on specific infections contains an excellent section on syphilis and its treatment, and also quite a comprehensive account of tropical surgical diseases. In the chapter on burns and scalds is to be found a photograph of a patient with burns of the face treated by tannic acid spray and with his fingers covered with tannic acid compresses. This must have been left in by accident because it is directly contrary to the present consensus of opinion, and not in keeping with the rest of the article, which is sufficiently up to date to mention Bunyan's silk envelope technique.

Volume two describes regional surgery, and in it every important subject has its fair share of space. The chapters on subjects such as the eye, ear, nose, and throat have been written by specialist contributors and have all been carefully revised and brought up to date in keeping with the main part of the work. Although this edition is a wartime production, its printing, paper and binding are in no way inferior to those of its predecessors, and it is still sold at a gratifyingly cheap price.

W. McN. N.

**GYNAECOLOGICAL OPERATIONS.**—By J. Lyle Cameron, M.D., F.R.C.S. (Eng.), F.A.C.S., M.R.C.O.G. 1941. Oxford University Press, London, Humphrey Milford. Pp. 200. Illustrated. Price, 21s. Obtainable from Oxford University Press, Bombay and Calcutta

This book is a collection of the usual gynaecological operations which are to be found described in the various textbooks.

While it is no doubt of advantage to be in possession of a volume which contains all these operations, yet there is nothing new in this book nor does it contain anything of special recommendation. It commences with a description of the usual incisions, and preparation of the patient. Then vulval, vaginal, cervical, and abdominal operations are dealt with in turn, and the usual methods described.

The author takes the opportunity to go fully into some of the lesser known plastic operations, such as making a vagina for atresia or absence of that organ, but on the other hand is reticent about more usual procedures, such as transplantation of ureters into the pelvic colon in cases of inoperative vesico-vaginal fistula. Indeed the whole treatment of this condition is described in little over one page.

For quick reference to refresh one's memory, this book will be useful, but it cannot take the place of the larger textbooks.

H. E. M.

**DISEASES OF THE NERVOUS SYSTEM: DESCRIBED FOR PRACTITIONERS AND STUDENTS.**—By F. M. R. Walshe, O.B.E., M.D., D.Sc., F.R.C.P. (Lond.), Hon. D.Sc., Nat. Univ., Ireland. Second Edition. 1941. E. and S. Livingstone, Edinburgh. Pp. xvi plus 325. Illustrated. Price, 12s. 6d. Postage: Inland, 7d.; Abroad, 1s.

THE reviewer has hardly been able to keep the first edition of this book at hand more than a month at a time since it was published last year, as it was repeatedly borrowed by his friends. Now, with the publication of the second edition he has been made to part with the first.

It is not hard to understand why this book has become so popular among medical students. Within the pages of a single volume of modest size are to be found the principles of neurology described in very simple language.

The changes that have been made in the present edition are not many, and perhaps would not have called for a new edition had the previous one not been exhausted, in less than a year's time.

Nevertheless, the text-matter has been increased by about forty pages, and a number of illustrations, including a few on art paper, have been added, but the price is not increased.

Considering the favourable reception given to the first edition, it is obvious that the book will continue to be useful to the wide circle of readers for whom it is intended.

R. C.

**TEXTBOOK OF HISTOLOGY FOR MEDICAL STUDENTS.**—By Evelyn E. Hewer, D.Sc. (Lond.). Second Edition. 1941. William Heinemann (Medical Books), Limited, London. Pp. xi plus 364. Illustrated. Price, 17s. 6d.

THIS is the second edition of Hewer's textbook on histology. The first edition which appeared in 1937 has been twice reprinted since then. This speaks of the popularity of this book. To a medical student the study of histology might appear very dry and uninteresting, if he is told to focus his attention on the cellular structure only, but if he is given any idea of the immensely complex and mysterious functions that these minute microscopical elements of the animal body are capable of performing, he finds a living interest in the study of histology. This important fact has been well realized by the authoress and she had given prominence to physiological changes of tissue cells. The book is richly illustrated which is of course very desirable in every book of histology. The diagrams are excellent and very illustrative, but I have to offer some criticism with regard to the photomicrographs; many of these are too dark in print (figures no. 130, pp. 148, no. 204, pp. 223 and no. 130, pp. 148). The result is that details have not been shown very well. This book is intended for the beginners to whom the subject should be presented with as much attraction as possible. Barring this minor defect, this volume of histology is very valuable for the students and teachers of the subject.

B. P. T.

## Abstracts from Reports

**THE ROSS INSTITUTE OF TROPICAL HYGIENE. INDIA BRANCH. REPORT OF THE COMMITTEE OF CONTROL FOR THE YEAR ENDED 31ST JULY, 1941**

THIS is the second report of this organization since a local committee of the Ross Institute was founded in Calcutta.

It gives a record of widespread and valuable work principally in malarial control, but other public health measures have also received some attention. The report is mainly composed of abstracts from the reports of numerous tea estate medical officers in which figures play the most prominent part, therefore it does not lend itself to abstraction.

The function of this branch of the Ross Institute appears to be of general supervisory character under their technical adviser Dr. Ramsay, but most of the actual work is carried out by individual medical officers and it is not a charge on the funds subscribed to the branch.

**ANNUAL REPORT ON THE BERRY-WHITE MEDICAL SCHOOL, DIBRUGARH, FOR THE YEAR 1940-41. BY LIEUT.-COLONEL A. M. V. HESTERLOW, M.B., Ch.B. (EDIN.), B.Sc., P.H. (EDIN.), D.T.M. & H. (EDIN.), I.M.S., INSPECTOR-GENERAL OF CIVIL HOSPITALS, ASSAM**

DURING the year the Medical School worked satisfactorily. The changes in the staff did not have any disturbing influence on the steady work of the school. The percentage of attendance, however, is 83.62 against 81.93 in the previous year. While this is an improvement, it cannot be looked upon as satisfactory, when it is considered that the students live in a hostel attached to the school. There is nothing in the report to indicate to what this low percentage of attendance may be due. It may be due to illness, which would have to be rather frequent or prolonged to give such a poor attendance, or it might be due to a certain lack of control in the hostel.

There appears to be no medical inspection of the students such as obtains in some of the other Government Colleges in Assam. It would be a very important matter to establish a regular medical and physical inspection of the students in the Medical School, for apart from being a great aid in the preservation of the health of the students it would be a very great asset on the teaching side of the school for making exact observations on the effects of specialized education of a rather exacting nature on young adults, for accumulating data on these problems and for working out under the best auspices practical methods of dealing with the problem of medical inspection of schools as a whole.

There should be a considerable improvement in the teaching of hygiene and vaccination. As an indication of apparent lack of appreciation of the importance of these subjects is the fact that the students of the class do not have any practical training in vaccination. This should be remedied and the students themselves should be obliged to perform a certain number of primary vaccinations and to observe and report on the results. The Dibrugarh Municipal area will provide the most natural field for the development of this improvement. The teacher in these subjects has no public health qualification. It is essential that the teacher in hygiene and vaccination should have such a qualification.

The necessity for a hostel for the women students has become more urgent than ever on account of the decision to admit four women students each year. The renting of private buildings will never provide the convenience and advantages which a college hostel built for the purpose undoubtedly has. It is the provision of hostels in the medical schools in the country and the obligatory residence of the students in these hostels that has been the salvation of medical school education, and the development and maintenance of the high standard this education has reached in so many parts of the country. As the need for the preservation of the health of the women of the land becomes more and more appreciated, women doctors in their training should not be placed under the handicap of their not having the advantages of a hostel of their own, for only in this way can be developed the self-reliance and co-operative effort and co-ordination which are essential for any body of medical practitioners and more particularly for women doctors in the pioneering work that they have to do.

**ANNUAL REPORT ON MEDICAL DEPARTMENT OF THE GREAT INDIAN PENINSULA RAILWAY, BYCULLA, BOMBAY, FOR THE YEAR 1940-41**

**Malaria.**—The average number of certified days of absence on account of malaria and other fevers per employee per year was 3.37 as compared with 3.47 for the last year. The incidence of malaria increased from

July attaining its maximum in October (1,095 cases) after which it declined to a minimum in March (513 cases).

**Influenza.**—Influenza was prevalent throughout the year with a maximum incidence in October (984 cases) and minimum in June (485 cases). The number of cases reported was 8,411 with 12 deaths as compared with 8,709 cases with 10 deaths in 1939-40. The percentage incidence of influenza was 9.8 against 11.04 per cent last year. Of the cases treated, 81 were in-patients and 8,330 out-patients. The case mortality was 1.42 per 1,000 against 1.15 last year, and the average monthly incidence was 700.9 cases. Amongst families, 3,708 cases of influenza were treated. No deaths were reported. During the last year, 4,457 cases were treated with two deaths. Of the cases treated this year six were in-patients.

**Veneral diseases.**—One thousand and twenty-two cases were registered against 966 cases in the previous year. Of these 497 were gonococcal, 107 soft sore and 418 syphilitic infections. The returns for families show 122 cases treated against 122 cases treated last year. Of these, 41 were gonorrhoea, 5 soft sore, and 76 syphilitic infections, the corresponding figures for these for the last year being 39, 6 and 67 respectively.

**Enteric fever.**—Cases of enteric amongst the employees numbered 72 with 3 deaths against 59 cases with 6 deaths last year. The case mortality was 4.1 per cent of the total cases treated.

**Tuberculosis of the lungs.**—The number of employees treated for tuberculosis of the lungs was 156 with 20 deaths against 142 cases with 20 deaths last year. These cases are not generally fit for continued employment, and the majority are invalidated out of the service. Selected cases are sent to sanatoria with the help of monetary grants from the Staff Benefit Fund and eventually return to useful work. The prolonged periods of sick leave of these cases materially influence the sick rate figures. There can be no doubt that tuberculosis is more frequently met amongst the staff than it was a few years ago. Most of the cases are pulmonary, and in view of its insidious nature and the prolonged invalidism associated with it, it may be advisable in the near future to take special precautions in the examination of recruits by x-ray screening. Pulmonary tuberculosis carries a high death rate, viz, 20 out of 156 or 12.8 per cent of the total cases treated.

**Injuries.**—Compared with the figure for the last year, there is an increase of 1,467 or 8.1 per cent. Of these injuries, 13,786 occurred while on duty and the balance, viz, 4,253, off duty. The number of deaths reported this year is 11 against 8 in the previous year.

**Certified days of absence.**—The number of certified days of absence due to injuries sustained on and off duty amounted to 116,444 which, compared with last year, shows a decrease by 11,085 days. Accidents are responsible for 13.55 per cent of the number of days lost on account of sickness during the year. Out of the figure only 10.98 per cent is attributable to injuries on duty. The average number of days of absence per employee per year was 1.35 against 1.62 last year.

**REPORT ON THE WORKING OF THE PUNJAB MENTAL HOSPITAL, LAHORE, FOR THE YEAR 1940**

THE provision of additional accommodation, both in the male and female section of the hospital, has resulted in an increase in admissions and in the number of cases treated. The total number of patients admitted, including re-admissions, during the year under report, was 331 (274 males and 57 females) against 262 (230 males and 32 females) in 1939—an increase of 69. The total number of patients treated in the hospital in 1940 was 1,366 (1,094 males and 272 females) compared with 1,299 (1,055 males and 244 females) in the preceding year. There was a corresponding increase in the daily average strength which rose from 1,037.65 in 1939 to 1,090.84 in the year under review. The maximum number of patients under treatment on any one night was 1,151 (921 males and 230 females) against

1,058 (843 males and 215 females) in the previous year. The capacity of the hospital, computed at a minimum of 70 square feet per patient, is 1,408 patients (males 1,126 and females 282). The additional accommodation includes three new barracks capable of taking 300 patients in the male section and a double-storeyed block for 100 patients in the female section of the hospital.

The health statistics reveal an all-round improvement. The daily average number of sick during the year under report was 40.06 compared with 63.06 in 1939. The total number of deaths in the hospital was 31 against 47 in the previous year. The death rate was 2.84 per cent on the daily average strength and 2.42 on the new admissions in 1940 compared with 4.52 and 5.72, respectively, in the preceding year. The death rate would have been still lower but for an unfortunate outbreak of colitis—due to food poisoning—in the female section. This cause accounted for 5 deaths. Pneumonia claimed the largest number of victims—6 deaths. There was no case of suicide or escape, although a considerable amount of freedom was afforded to patients. There was one case of assault, in which one convict (who had almost recovered from insanity and was shortly to be transferred to a jail to undergo the unexpired portion of imprisonment) attacked another criminal patient with fatal results. The attack was prompted by a personal grudge. The cost of maintenance per patient recoverable from ordinary paying patients and other provinces was raised from Rs. 20 to Rs. 25 per mensem with effect from 1st January, 1940, and is stated to be sufficient for covering the expenditure that has to be incurred.

#### REPORT OF THE EUROPEAN MENTAL HOSPITAL AT RANCHI FOR THE PERIOD 1ST JANUARY, 1940, TO 31ST MARCH, 1941. BY MAJOR MOORE TAYLOR, O.B.E., M.D., D.P.H., I.M.S., MEDICAL SUPERINTENDENT

The Government of India was pleased to accept the proposal of the Board of Trustees that, subject to certain conditions, ten beds be made available for Indian paying patients of European habits. Nine male Indian patients were treated during the period under report, four of whom were voluntary boarders. There were three in hospital at the close of the year. The number of patients resident in the hospital at the commencement of the period under report was 251 (males 112, females 139) as compared with 253 (males 117, females 136) in 1939. There was no outbreak of an epidemic nature, and the general health throughout the period under report was satisfactory. The daily average of sick treated in the hospital infirmary was 3.5 per cent of the population, as compared with 3.2 per cent in 1939. The most distinctive causes for admission were, malaria, influenza (mild), debility, filariasis, fracture, abscess and other septic conditions.

During the period under report three female patients were allowed by the Board of Visitors leave of absence from the hospital for a period of two months. In two cases reports were received at the end of the periods that the patients were well, and they were discharged from the hospital, being shown in the statistics as 'improved', and one patient returned to the hospital. *Treatment.*—The condition of every patient on admission is thoroughly investigated; the routine consisting of a complete physical, pathological and psychological examination. This is followed by dental, ear, nose and throat, and, where indicated, ophthalmic examination. Thereafter treatment is prescribed, and all patients are given the benefit of whatever special treatment is indicated. The treatments now in common use are cardiazol shock therapy, prolonged narcosis, malariotherapy, pyrectotherapy, hydrotherapy, occupational therapy, in addition to whatever physical, medicinal or endocrine therapy may be called for in individual cases. Shock therapy is expensive, highly

specialized and takes three or four months to complete in any one case, but its results are encouraging. It offers the only hope of cure or amelioration in certain cases of schizophrenia. In spite of the difficulties and dangers of the treatment it has justified itself as a form of therapy. Treatment by prolonged narcosis is found particularly useful in states of excitement and especially in the manic-depressive psychoses. Hydrotherapy is an important form of treatment in many types of mental disorder and is used extensively in this hospital. The detailed technique of all methods of treatment has been dealt with in previous annual reports of the hospital, and repetition is, therefore, unnecessary.

Mrs. Emslie Hutton, M.D., Honorary Physician, the British Hospital for Mental and Nervous Disorders, London, paid a visit to the hospital in September 1940. Dr. Hutton's note on the hospital will, no doubt, be of interest to contributing Governments. It is as follows:—

'I journeyed to Ranchi to visit this Mental Hospital, but never expected to see one so nearly ideal. In fact, of all the Psychiatric Clinics that I have seen in Europe and America, this one combines the most good features and fine principles in its management.

I was greatly impressed by the humanitarian and kindly atmosphere which pervades the place, and by the real hospitalization of the patients. They have the benefit of individual attention by the medical staff (it is a pity there is no woman physician on the staff), and of skilled mental nursing by women. The building lends itself well to real hospital treatment with its spacious verandahs and wards, its wide lawns and gardens and its general air of hopefulness and normality. It was splendid to see that there were no locked doors and that there were a number of small cottages and garden rooms, each arranged to house one or two patients; these two features might be copied by all mental hospitals with great benefit and comfort to the patients.

The medical treatment is on modern lines, and here new treatments are investigated, tried out, and those which are beneficial are retained. Tradition, too, evidently means something here, and it was pleasant to note the naming of the various blocks.

The routine, with its daily community singing, exercises and occupational therapy, its regular games, dancing, concerts and cinemas, is highly organized and most interesting. It is a great advantage that there is a music mistress and a physical instructor on the staff.

The hospital might well serve as a model for others in India and elsewhere. It was a great pleasure to see this very excellent and modern clinic, and it is to be hoped that many doctors and members of the general public may be able to make the journey to see it and so obtain, as I did, inspiration from much that I saw.'

*Occupational therapy* continues to be one of the main features of the hospital. The average number of patients employed in useful tasks in the hospital represents over 80 per cent of the population. All nursing sisters are now fully qualified to supervise this treatment, either in the Occupational Therapy Department or in the wards. Most of the articles made in the department are utilized in the hospital, but any surplus stock is sold to the public. During the period under report the total sales to the public from this department amounted to Rs. 1,264. The sales during 1939 amounted to Rs. 820.

*Diversion.*—Classes in physical drill, folk-dancing and games are held daily, and the patients, assisted by the staff, staged a number of excellent concerts during the year. Parties attended the cinema at the Indian Mental Hospital when English films were being shown. The social evenings and dances were being continued, and a full Christmas programme was brought to a close with the usual fancy dress ball. The cricket, football, and hockey teams played a number of friendly matches on the hospital grounds, and also at Ranchi, some of which they won.

## Service Notes

### APPOINTMENTS AND TRANSFERS

**SURGEON-COMMANDER G. W. MILLER**, Principal Medical Officer, Royal Indian Navy, is appointed to carry on the duties of the post of Port Health Officer, Bombay, in addition to his own duties, *vice* Major Bozman, granted leave, until further orders.

Major R. I. Reid is appointed Director of Production Instruments and Appliances, in the office of the Director-General, Indian Medical Service, with effect from the 19th July, 1941.

Major A. A. Pullar, Presidency Surgeon, Bombay, is appointed Honorary Surgeon to His Excellency the Governor of Bombay, with effect from the 3rd November, 1941, in addition to his own duties.

Major F. R. W. K. Allen, Superintendent, Central Jail, Jubbulpore, is reverted to the Medical Department and posted as Civil Surgeon, Raipur. He made over charge at Jubbulpore on the forenoon of 30th October, 1941, and assumed charge at Raipur on 6th November, 1941 (forenoon).

### INDIAN LAND FORCES

*(Permanent Commission)*

*To be Captain (on probation)*

Vishwanath Prasad Gupta. Dated 15th November, 1941, with seniority 15th November, 1936.

*(Emergency Commissions)*

*To be Captains (on probation)*

2nd June, 1941

Piyare Lal Burman, with seniority from 2nd June, 1935.

5th July, 1941

Krishna Chandra Varma, with seniority from 5th July, 1934.

6th July, 1941

Louis Oswald, with seniority from 19th July, 1934.

19th July, 1941

Mool Singh Bazaz, with seniority from 19th July, 1938.

3rd August, 1941

Phanindra Krishna Gupta, with seniority from 1st April, 1936.

*To be Lieutenants*

26th December, 1940

Peter Anthony Lane Roberts.  
Edward George William Lynch.

13th March, 1941

Colin Monroe Bisset.

27th March, 1941

Howard Raymond Cara.  
William Leslie Percival Spicer.

12th June, 1941

Edward Dunskey.

*To be Lieutenants (on probation)*

5th July, 1941

Bishamber Nath Blaggan.

Boddapati Amrit Rao.

Hans Raj Nischol.

Ramah Sukumaran.

Vasudeva Krishna Row.

Ramesh Chandra Biswas.

Jonnalagadda Surya Prakasa Rao.

Brij Ballabh Prasad.

Kundan Singh Gill.

Jiban Krishna Sarkar.

Gopal Ganesh Sahasrabudhe.

Vasudeo Anant Mauskar.

Muddassin Khan.

Rabindra Nath Sen.

Shiv Dev Singh.

Chhajju Ram Abrol.

Uttam Singh Sidhu.

Gurditta Mal Diwan.

Pargat Singh.

Krishan Gopal Bhatia.

Rabindra Nath Gupta.

Rustom Sohrab Tata.

Nellorepalle Venkata Subrahmanyam.

Revur Krishnamurti.

Arumugam Pillai Thiagarajan.

Cortielle Madhavan Nair.

Rajanga Nataraja Aiyer.

Viswanatha Sankaran.

Iftakhar Jahan.

Charlie Lachlan Joshee.

Balai Lal Roy Chowdhury.

Anil Kumar Bose.

Yeshwant Govind Joshi.

Duraiswami Jayaram.

Iekshumana Rajagopala Marthandam.

Mayavaram Venkatarama Ramachandran.

Chambathil Ramanunni Mannadiar.

Kandukur Prabhakaram.

Dady Framji Vachha.

Mukkai Subramania Mahadevan.

Arcot Govindaraj Rangaraj.

Reginald Anthony Jansen.

Palathiruthi Achutha Menon.

Noble Adishesiah.

Tindivanam Ramanujam Muthurangam.

Tanjore Daivasikhamani Gowri Sankar.

Sardari Lal Bhandari.

### INDIAN MEDICAL SERVICE (DENTAL BRANCH)

*(Emergency Commissions)*

*To be Lieutenants (on probation)*

5th July, 1941

Sheikh Fazle Ilahi.

Ram Pratab.

Mulk Raj.

Vidya Sagar Sehgal.

Jai Ram Das Abuja.

Mohammed Shafique.

6th July, 1941

Walter Joseph Siqueira.

Pratibha Ranjan Dutt.

Mohan Hatangdi.

Gobinda Prasad Halder.

Raghunath Singh Hoon.

Mammen Mammen.

Chirayath Francis Varied.

Narayan Prasad Mahapatra.

7th July, 1941

Guruswami Audikesavalu Naidu.

10th July, 1941

Rishiyur Sundaram Thyaga Rajan.

5th August, 1941

Phiroze Jehangirji Engineer.

Panakkal Othuppu Ittooppunny.

Thakar Das Narang.

Sardari Lal Kalra.

Bhag Singh.

Vepa Purna Rao.

Allen Arthur Rawat.

Profulla Chandra Sen.

Lakshminarayanapuram Krishna Ayyar Ananta-narayanan.

Agha Fakhar Hussain.

Rai Sahib Lakshman Prasad Misra.

Narayan Gangadhar Chitnis.

Thiruvengadham Pillai Durairaj.

Charu Bhavanishankar Bhargav.

Vinay Bhavanishankar Bhargav.

Isfendiyar Khan.

Tadimalla Rama Seshagiri Row.

Fakir Chandra Mukherjee.

Jal Hormajshaw Chibber.

Gopal Laxman Chitale Bhajekar.

6th August, 1941

Devki Nandan Mehta.

Gursewak Singh Sidhu.

Binaya Krishna Bhattacharyya.

Gauri Shankar Singh.

Manmatha Nath Ghosh.

Mafizuddin Talukdar.

5th September, 1941

Lalgudi Annadurai Venkataraman.

Balwant Singh Sachdev.

Ashiq Hussain.

Vadarangam Swaminadha Mahadevan.

Jyotish Chandra Ghosh.

Tattamangalam Subramaniapattar Viswanathan.

John John Eapen.

Abdul Kadeer.

Madan Lal Madan.

Perinbam Thanaratnam.

Charanjit Singh Mehdiratta.

Tulsi Charan Bose.

Panthalingal Krishna Menon.

Dilbagh Rai Mendiratta.

Sabodh Kumar Rana.

Nuruddin.

Jagjit Singh.

Jagannath Anantrao Sonde.

Shrikrishna Shridhar Godbole.

Konat Narayanan Pillai Sankara Pillai.

Duvoor Jagannatha Reddy.

Mahmood Ali Khan.

Vasudeo Balakrishna Kale.

Alacandy Raghavan.

Gondi Herbert Samuel David.

Poosapati Raghunadharaju.

Mathura Prasad Varma.

Natarajan Venkataraman.

Natarajier Krishnaswami.

6th September, 1941

Prafullah Kumar Ray.

Amarendra Kumar Daw.

Chintaman Shringapure Ramchandra.

Binay Kumar Nandy.

Benoy Krishna Bose.

Syed Ghaus Mohammad Shah.

Mohammad Khurshid Akhtar.

Chaudhri Khurshid Hasan.

Shreedhar Shreenivas Kirtane.

Sadashiv Mahadev Apte.

## LEAVE

Major C. A. Bozman, Port Health Officer, Bombay, is granted leave on average pay for 3 months, with effect from the afternoon of the 18th October, 1941.

## PROMOTIONS

The undermentioned officer is granted the local rank of Brigadier, without effect on pay and pension:—  
Colonel R. V. Martin, C.I.E. Dated 1st October, 1941.

*Lieutenant-Colonel to be Colonel*

W. R. Stewart, C.I.E. Dated 12th July, 1941, with seniority from 31st July, 1936.

*Major to be Lieutenant-Colonel*

T. A. Doran. Dated 22nd November, 1941.

*Note.*—The seniority of Captain H. B. Wright in his present rank, notified in a previous Notification, is antedated to 7th May, 1933.

The seniority of Captain S. M. Basu in his present rank is antedated to 4th January, 1937.

*(Emergency Commission)*

*Note.*—The seniority of Captain C. V. Ramchandani in his present rank is antedated to 24th September, 1935.

The seniority of the undermentioned officers in their present rank is antedated to the dates shown against their names:—

Captain C. L. Bhola. Dated 15th January, 1935.

Captain C. V. Krishnaswami. Dated 17th February, 1938.

Captain R. Kasliwal. Dated 23rd September, 1935.

Captain L. Nandkeelyar. Dated 1st February, 1940.

Captain A. L. Som. Dated 15th July, 1940.

Captain N. Dutt. Dated 1st August, 1940.

Captain S. L. Rikhye. Dated 1st March, 1941.

Captain M. G. Hyder. Dated 19th March, 1941.

Captain M. Said. Dated 23rd March, 1941.

*(Short Service Commissions)*

*Note.*—The seniority of the undermentioned officers in their present rank is antedated to the dates shown against their names:—

Captain S. A. Mian. Dated 29th October, 1936.

Captain M. S. Rao. Dated 9th December, 1936.

Captain S. A. Hasan. Dated 22nd December, 1936.

Captain V. R. Damle. Dated 29th March, 1937.

Captain P. Dass. Dated 11th June, 1937.

Captain B. Bhattacharjya. Dated 12th July, 1937.

Captain B. I. S. Bhalla. Dated 12th July, 1937.

Captain P. N. Bardhan. Dated 12th July, 1937.

Captain R. L. Mehra. Dated 12th July, 1937.

Captain D. Bhatia. Dated 12th January, 1939.

Captain N. Jungalwalla. Dated 1st February, 1939.

Captain P. C. Dhanda. Dated 22nd June, 1939.

Captain P. T. Joseph. Dated 22nd June, 1939.

Captain H. R. Pasricha. Dated 22nd June, 1939.

Captain M. Sarwar. Dated 22nd June, 1939.

Captain D. K. Bose. Dated 22nd June, 1939.

Captain N. D. P. Karani. Dated 12th July, 1939.  
 Captain N. Chakravarti. Dated 22nd December, 1939.

*Note.*—The seniority of Captain N. A. A. Khan in his present rank is antedated to 23rd September, 1940.

*(Emergency Commissions)*  
*Lieutenants to be Captains*

15th June, 1941

M. H. Alvi.

15th August, 1941

N. R. Gupta.

15th October, 1941

|                       |                      |
|-----------------------|----------------------|
| A. Bhattacharjee.     | P. B. Menon.         |
| B. B. Sen Gupta.      | A. S. L. Narasimham. |
| K. B. Sen.            | S. A. R. Iyengar.    |
| D. K. Ghoshal.        | M. V. Krishnamurthy. |
| H. Sen Gupta.         | I. R. Rao.           |
| B. M. Sinha.          | S. Rodrigues.        |
| S. K. Ghose.          | S. C. Roy.           |
| S. N. Sinha.          | S. C. Ghosh.         |
| C. K. Kesavan.        | H. C. Mediratta.     |
| C. S. Krishna Murthi. | R. R. Reddi.         |
| S. K. Choudhury.      | S. V. Menon.         |
| K. C. Hazra.          | C. Bhadraiah.        |
| M. P. Sarma.          | M. M. Hossain.       |
| P. C. Koshy.          | V. R. M. Sadasivan.  |
| S. K. Ray.            | L. Verghese.         |
| G. Sambasivan.        | S. Ghose.            |
| K. K. Nayak.          | S. Mukerjee.         |
| B. L. Raina.          | S. Kaul.             |
| P. A. Paul.           | M. Ramzan.           |
| V. Ranghachari.       | Z. A. Choudhuri.     |

16th October, 1941

T. A. Naidu. M. A. M. Choudhry.

1st November, 1941

|                         |                        |
|-------------------------|------------------------|
| B. L. Malhotra.         | K. Mariswamappa.       |
| N. C. V. Raman.         | V. S. Iyer.            |
| R. V. R. Rao.           | P. K. Antony.          |
| S. Banerjee.            | P. P. Singh.           |
| D. S. Patkar.           | O. C. Mathur.          |
| M. S. Menon.            | A. G. Siddiqi.         |
| P. K. Nayak.            | M. Ibrahim.            |
| K. M. Rao.              | A. G. J. P. Fernandes. |
| M. B. Nair.             | S. B. Singh.           |
| J. P. Zachariah.        | M. Aslam.              |
| K. Bhaskaran.           | G. M. Das.             |
| B. C. Karmaker.         | D. S. Shukla.          |
| K. Parthasarathy.       | S. Prakash.            |
| C. Joseph.              | K. L. Gupta.           |
| A. I. Lakshminarayanan. | K. A. Malik.           |
| P. V. Venkatachalam.    | V. L. Parnaik.         |

K. L. Datta.

2nd November, 1941

B. Mukerji.

15th November, 1941

|                   |                    |
|-------------------|--------------------|
| P. N. R. Setty.   | P. N. Bose.        |
| N. Rangavadevelu. | N. V. Gharpure.    |
| M. G. Nayar.      | K. Banerjee.       |
| D. R. Vaidya.     | L. S. Nathan.      |
| M. J. Ahmadi.     | T. T. Ramalingam.  |
| S. B. Lal.        | P. K. Chatterjea.  |
| N. Ahmed.         | A. K. Jadeja.      |
| N. K. Roy.        | M. R. Vachha.      |
| M. S. Khan.       | A. R. Ramanathan.  |
| A. S. Gharjakhia. | R. A. Riyaz.       |
| S. N. Mukerji.    | R. C. D. Tarapore. |
| S. H. R. Shahid.  | C. L. Kashyap.     |
| V. T. Kuriyan.    | M. V. Sarma.       |
| S. P. Dutt.       | A. K. Barat.       |
| V. R. Kamath.     | B. B. Mandal.      |
| M. B. Hasan.      | K. K. Seal.        |
| B. S. Saxena.     | J. M. Sinha.       |

A. H. Hamid.

16th November, 1941

A. B. Roy. J. Ramakrishnayya.  
 M. G. Pendharker.

18th November, 1941

B. M. Ambady. T. R. A. Vaidya Nath.

*Note.*—The undermentioned Lieutenants (on probation) are confirmed in their rank, with effect from the dates specified:—

M. H. Alvi. Dated 15th June, 1940.

N. R. Gupta. Dated 15th August, 1940.

M. A. M. Choudhry. Dated 16th October, 1940.

## Notes

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## Original Articles

### TREATMENT OF CHRONIC INTESTINAL AMOEBIASIS

#### USE AND ABUSE OF EMETINE

By SIR R. N. CHOPRA, C.I.E., M.A., M.D., S.C.D. (Cantab.),  
F.R.C.P. (Lond.)

COLONEL, I.M.S. (Retd.)  
and

I. C. CHOPRA, M.R.C.S., D.T.M.

(From the School of Tropical Medicine, Calcutta)

**Introduction.**—The literature on the use of emetine in the treatment of intestinal amoebiasis is extensive and the general consensus of opinion with regard to it may be summed up as follows:—Firstly, that emetine injections are by far the most satisfactory immediate line of treatment of an acute attack of amoebic dysentery; and, secondly, that emetine therapy is generally a failure in the treatment of chronic intestinal amoebiasis and the carrier condition. Our own experience during the past 20 years confirms these views. This paper is based on 1,105 cases of intestinal amoebiasis treated by the senior author in the Carmichael Hospital for Tropical Diseases.

In India, when amoebic dysentery is diagnosed or even if *Entamoeba histolytica* is not discovered and a diagnosis is made on purely clinical grounds, emetine injections are often given immediately and a course of nine injections is prescribed. We have also seen emetine being administered even when the case is evidently not of acute amoebic infection, but belongs to the bacillary variety. The reason for such use is that emetine has got remarkable properties of alleviating the distressing symptoms occurring in acute dysenteric infections of all kinds.

**Occurrence of active and cystic forms.**—There is also an impression among medical practitioners in this country that, if trophozoites of *E. histolytica* are present, emetine is effective in chronic intestinal amoebiasis. It is believed that when cysts are present emetine is not effective because it has no action on the cysts.

It must be stated here that *E. histolytica* is an obligatory pathogenic organism and lives and multiplies in the tissues of the host. The active stage of the organism outside the body lasts only a few hours. The opinion now held is that when amoebic infection is present there is always ulceration in the gut. In sub-clinical intestinal amoebiasis, where no gut symptoms are present, the ulcers may be very small, pin-point in size, but their presence is considered to be essential for entamoebæ to live and multiply. *E. dispar* is considered to be identical with *E. histolytica*.

The lesions in the gut in histolytica infection are generally in the upper part of the large intestine. In severe infection the lower part

(sigmoid) is also affected and sometimes the distal part of the small intestine also has ulcers. Active forms of *E. histolytica* are present in the tissues; cyst formation only takes place when these amoebæ leave the tissues, come into the lumen of the gut and find the environment there unfavourable for their existence. These cysts are resistant forms which can live both in the lumen of the gut for prolonged periods and outside the body also, in damp environments. Dry heat kills them quickly. Encystation generally takes place in the lumen of the large gut where the contents are solidifying. After going through the pre-cystic stage the cystic forms are produced. Both trophozoites and cysts may be present together in chronic amoebiasis. Histolytica infection is often associated in this country with *Entamoeba coli*, *Iodamoeba butschlii* and *Endolimax nana*; *Giardia lamblia* and other flagellates also occur and hookworms, roundworms and threadworms are often associated.

Diagnosis of histolytica infection can be made by examining a fresh stool, but errors in diagnosis are common. No reliance can be placed on suspected non-motile or dead amoebæ in stools. To the practised eye it is not difficult to recognize the *Entamoeba histolytica*.

Charcot-Leyden crystals are commoner in chronic amoebic dysentery than in the bacillary form but are not pathognomonic of this condition. Sigmoidoscopic examinations are helpful, and entamoebæ may be found in scrapings from ulcers in long-standing cases. Craig (Musser, 1938) has introduced a complement-fixation test which is somewhat difficult to perform and is not in common use.

In the relapsing type, entamoebæ are sometimes easily found in the stool and the very first examination may reveal them either in active or cystic form. In other cases after repeated examinations the parasites may not be found even after administration of purgatives. This is often the case when the patient has recently undergone treatment with emetine or other amoebicidal remedies. Parasites are sometimes discovered only after more than 10 to 15 daily examinations.

Amoebic infection may persist for many years and in some of our cases had lasted more than 15 years. Periodic relapses may or may not occur. There were periods of quiescence lasting for many years, during which the patients enjoyed good health.

**Sub-clinical amoebiasis.**—The degree of severity of symptoms in *E. histolytica* infection varies greatly. These differences are due to variations in the resistance of different individuals to the inroads of the parasite, and to the virulence or tissue-attacking power of various strains of the parasite. Further, it should be realized that the influence of environment (the gut) is an important factor. Stasis of the contents plays an important part in determining

the severity of the symptoms and the type of lesions produced. The degree of pathological change may vary enormously. In quite a large number of cases met with in this country, few or no symptoms associated with intestinal amœbiasis are present, the patient generally seeking advice for some other complaint. We have had patients coming for chronic dyspepsia (flatulence, meteorism, etc.), asthma, dermatitis, urticaria and other skin diseases, low pyrexia, migraine, feeling of tiredness, malaise, etc., in which the cause on investigation was found to be amœbic infection and proper treatment relieved the symptoms completely. There were also cases where no symptoms were present, the individual being apparently in good health. Active and cystic forms may occur without there having been any history of an attack of dysentery.

*Why is emetine effective in acute amœbic infection and not in the chronic form?*

In acute amœbic infection, the amœbæ are numerous and in full activity, and are amenable to the action of emetine. The reason is that the gut in this condition is in a hyperæmic state and emetine given in the form of injections quickly reaches the amœbæ, which lie in the ulcers, through the blood stream and destroys them. But even here, though injections control the urgent clinical manifestations, in the majority of cases, the infection is often not eradicated. It is now beginning to be realized that emetine after all is not the specific drug in the treatment of amœbiasis that it was imagined to be. Injections, especially of inadequate doses, may produce emetine-resistant forms; this fact is often not appreciated and one often sees cases which have had injections of  $\frac{1}{4}$  or  $\frac{1}{2}$  grain daily instead of effective doses of one grain.

In relapsing and chronic types of dysentery and especially in long-standing cases, fibrosis of the ulcerated area is set up and the capillaries are cut off, thus preventing the access to the parasite of emetine circulating in the blood. Entamœbæ lying in the necrotic and fibrotic tissue (which is avascular) are walled in and are thus liable to escape the action of emetine.

The second factor is the infection of the ulcers with intestinal bacteria, which irritate and promote pathological changes and lead to chronicity of the lesions. Further, with such added infection, the reaction of the gut becomes markedly acid and as emetine acts best in an alkaline environment, its action is hindered.

If energetic treatment is not started in the early stages of an acute infection before extensive destruction of tissues has taken place, relapses are almost certain to occur. Such symptoms as tenderness on pressure over the colon (especially the cæcum and the sigmoid), localized abdominal pain and thickening are frequently found. The liver is enlarged and tender when hepatitis is present.

### *Treatment of relapsing and chronic forms of amœbiasis*

In considering the agents available for the treatment of chronic amœbiasis, we must consider not only the relief of symptoms but also the sterilization of carriers, symptom-free or otherwise. In order to get at the entamœbæ one must have an agent which is absorbed and carried by the blood stream to the tissue-invasors and which at the same time is present in the lumen of the gut in adequate quantities to destroy both the non-motile and encysted forms. The drug further should be free from danger or discomfort to the host. Unfortunately no single substance is available which fulfils all these requirements. Yet by judicious and persistent use of one or more drugs, it may be possible to cure a large percentage of cases. It must also be stated that the disease cannot often be eradicated by giving just one or two courses of any remedy. We have found that in long-standing cases the treatment, both dietetic and medicinal, has to be continued for many months. We prescribe nothing less than three to four months' treatment in mild cases and in serious cases a much longer course may be necessary. The usual procedure adopted is as follows:—

The patient is put on a low-residue diet and a proper course of one of the amœbicidal drugs mentioned below (carbarsone, yatren, or kurchi alkaloids) is prescribed. This is followed by liquid extract of kurchi in doses of one to two drachms twice daily after meals for a period of two to three months. There is no doubt that the presence of kurchi alkaloid in the gut is unfavourable to histolytica. In cases where added infection with the dysenteric group of bacteria is present, a ten days' course of lactose in doses of three to four heaped teaspoonsful in a tumbler of water first thing in the morning is prescribed; lactic acid organism in form of *dahi* (curdled milk) or tablets of lactol are given at the same time. Lactose is absorbed sparingly from the gut and its presence there enables the lactic acid-forming organisms to grow and replace other organisms; in this way the intestinal flora is changed. If much mucus is present such drugs as *isapgul* are given. Frequent examinations of stools are made throughout the course to see if trophozoites or cystic forms are present. If these are discovered courses of amœbicidal drugs are repeated. The treatment may have to be continued for many months together.

Five groups of drugs are available in the treatment of chronic amœbiasis:

(1) *Emetine and emetine-bismuth-iodide.*—We have already explained that emetine given by injection does not cure chronic amœbic dysentery. Emetine by the mouth in form of emetine-bismuth-iodide is more effective, as it is absorbed from the gut and reaches the lesions by the capillaries; at the same time a sufficient concentration is maintained in the gut for direct

action on the parasites present in the ulcers and free in the lumen. Indian patients rarely stand more than two grains a day and the usual practice is to give it for ten consecutive days. The drug is administered in hard gelatine capsules at night before going to bed, three hours after a meal, and even then nausea and vomiting frequently occur. We had to use tincture opii in five to seven minim doses to enable the drug to be retained; according to Manson-Bahr (1941) luminal in doses of one grain is also very effective. Instead of giving two grains at once, it is often advantageous to give one grain repeated at an hour's interval. Emetine-bismuth-iodide, however, has not proved very successful in our hands. A combined treatment with emetine hydrochloride by injection in one-grain doses and emetine-bismuth-iodide in two-grain doses for a period of nine days has been tried.

The only condition in which injections of emetine are specific is amœbic hepatitis with or without abscess formation. A course of injections often acts like a charm and we have had cases in which apparently a large abscess had formed and showed signs of resolution after four or five injections of one grain each. We have also tried the alkaloids by injection and by mouth, as well as other amœbicidal drugs, without any effect whatsoever.

Emetine, however, is a very toxic drug; it has a depressant effect on the heart and nervous system. It is slowly eliminated; so it produces cumulative poisoning. The toxic effects observed are nausea and vomiting, diarrhœa, pronounced depression, both mental and physical, cardiac irregularities and fall of blood pressure. Muscular weakness with pain and tremors, and peripheral neuritis leading to paralysis of different groups of muscles sometimes occurs.

(2) *Quinoline derivatives*.—Yatren, introduced by Bayers, is the oldest member of this group. To this group also belong *chiniofon* which is official in the U.S.P. XI and contains 27 per cent of iodine. The other two substances similar to chiniofon are *vioform* and *diodoquin*. *Vioform*, which contains about 40 per cent of iodine, is not very soluble and is also somewhat irritant and liable to produce toxic effects. Recently another iodine derivative named *diodoquin* has been introduced which contains 64 per cent of iodine. All these compounds are believed to act on both motile and cystic forms. They are recommended in doses of one to two gm. daily for a period of ten days at least; two of them, i.e., yatren and another proprietary preparation enterovioform, have given satisfactory results in our hands. Retention enemas with 200 to 300 c.cm. of a 2.5 per cent solution retained for six to eight hours have been tried but they do not appear to hasten cure.

(3) *Organic arsenicals*.—These consist of stovarsol and carbarsone. The former drug is somewhat toxic and is liable to produce a red urticarial rash; carbarsone, however, in doses

of 0.25 gm. twice daily for 15 to 20 consecutive days has been intensively tried by us and has proved effective in our hands; little or no toxic effects have been observed. If the drug is administered with a small dose of salts in the morning to give one or two loose motions, the effectiveness is increased and the toxicity is reduced.

(4) *Kurchi alkaloids*.—The Indian species of *Holarrhena antidysenterica* contain conesine, kurchicine and kurchine. They have been shown to be effective in the treatment of both acute and chronic forms of intestinal amœbiasis. In our hands the bismuthous-iodide compound of the total alkaloids (kurchi-bismuth-iodide) in doses of 10 grains twice daily has given very satisfactory results. These alkaloids have no depressing effects on the heart and have low toxicity. They can, therefore, be administered in large doses and for prolonged periods. We have also found prolonged administration of a standardized liquid alcoholic extract of kurchi in doses of one to two drachms two or three times a day continued for two or three months effective in cases of amœbiasis where infection has existed for many years.

(5) *Palliative remedies*.—The last group of drugs used in the treatment of intestinal amœbiasis are certain palliative remedies, e.g., *Plantago ovata* (isapgul), *Aegles marmelos* (Bael fruit), certain species of *Psidium* (tukumalong), which are commonly used in this country. Others such as *Acorus calamus*, *Castellia nicholsoni* are used in America; *Monisernia ovata* and *Rhynchosia adenades* are used in South Africa. Their action is mainly due to two groups of substances which enter into their composition: (1) tannins which have an astringent and soothing effect, but have only a slight toxic effect on the *E. histolytica*. (2) Substances of the nature of mucilage which are contained in the cells of the epidermis. Their action is largely mechanical. They permeate the gut and are an unsuitable medium for the growth of micro-organisms present there; the bacteria are also entangled in their meshes and are passed out. The mucilage covers the surface of the ulcers and thus protects them from the irritating action of the intestinal contents and so promotes healing. This is the explanation why this class of substance has been held in great esteem in the indigenous medicine in India. We have used *Plantago ovata* either as whole seeds or separated pericarp in doses of four to six heaped teaspoonsful two or three times a day for prolonged periods in long-standing cases with extensive ulceration, with good results.

*Miscellaneous drugs*.—We have tried govano, sulphonamide derivatives, sulphoguanidine and a number of other drugs in chronic amœbiasis with disappointing results.

#### Summary

Emetine in form of injections has little value in the treatment of the chronic and carrier-forms

of intestinal amœbiasis. To give a course of injections of emetine in this condition is not only waste but abuse of the drug, as harmful effects may be produced by it. Emetine is a very toxic drug, and the manner in which it is often administered in this country, without confining the patient to bed, has occasionally been followed by serious toxic effects. This alkaloid has not such a specific action in intestinal amœbiasis as was once believed. Further, on account of the war, the supplies of this drug have been considerably reduced, and therefore not only emetine but all preparations of ipecacuanha should be sparingly used.

The chief indications for parenteral emetine therapy are, firstly, acute amœbic dysentery, and, secondly, amœbic hepatitis, with or without abscess formation. Emetine injections are indispensable in this latter condition, as no other drug has so far been discovered which has curative properties in this condition. Even for acute amœbic dysentery the quinoline derivatives, the kurchi alkaloids and carbarsone have in our experience proved to be almost as effective as emetine.

Emetine injections are indicated when acute exacerbations with troublesome symptoms occur in chronic amœbiasis. Three to four injections in doses of one grain daily put an end to the symptoms without producing cumulative toxic effects.

In chronic amœbiasis good results have been obtained with emetine-bismuth-iodide by mouth; one course often does not prove successful and several courses in increasing doses may have to be given. This drug has, however, all the depressing and toxic effects of emetine and in our experience has not proved very satisfactory in Indian patients.

Carbarsone, yatren, enterovioform and kurchi alkaloids have given very satisfactory results.

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## GASTRIC ACIDITY IN CHRONIC ULCERATIVE COLITIS

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### Introduction

CHRONIC ulcerative colitis frequently occurs amongst Indians and Europeans living in India and a number of patients with this condition are admitted every year to the Carmichael Hospital for Tropical Diseases. Many of these present a symptom-complex pointing to gastric trouble. In 100 such patients in whom the diagnosis was made after a barium meal, sigmoidoscopy, examination of stool, gastric acidity, etc., were also carefully determined. The result obtained in these investigations forms the subject-matter of this paper.

### Normal range of gastric acidity

This is believed to be between 20 and 40 c.cm. for Europeans. According to Bell (1922), the range is lower and should not exceed 30 c.cm. Napier with his long experience of Indian subjects demonstrated that the average normal range safely could be considered to be between 25 and 45 c.cm. According to Bhattacharya (1933), for the rice-eating population of Calcutta the range of acidity was rather on the high side. Rao (1937), on analysis of 100 Indian males from South India, observed that the acidity was, on the whole, high amongst them. Napier, Chaudhuri and Rai Chaudhuri (1938) observed that the incidence of high acidity was common among Bengalis who consume rice, and it was relatively low amongst Punjabis who are wheat consumers. This is further corroborated by the fact that peptic ulcer is more frequent amongst the rice-eating South Indian than in the case of the Punjabis who live on wheat.

### Laboratory tests

The gastric acidity was determined by alcohol test meals in preference to the gruel meal. Our cases were grouped according to Napier's classification of different ranges of gastric acidity which are as follows:—

*Hyperchlorhydria*—when the acidity is over 65 c.cm. of N/10 NaOH per 100 c.cm.; *high normal*—where it is over 45 but below 65 c.cm.; *normal*—between 25 and 45 c.cm.; *low normal*—between 10 and 25 c.cm.; *achlorhydria*—complete absence of acidity (HCl).

Examination of 100 cases of chronic ulcerative colitis in our series showed that *hyperchlorhydria* was present in 38 per cent of cases; *high normal* in 29 per cent; *normal* in 17 per cent; *low normal* in 4 per cent and *achlorhydria* in 12 per cent.

*Symptomatology*

Apart from the usual signs of colitis, such as slimy bloody stool, alternate constipation and diarrhoea, heaviness and flatulence, two characteristic features of the disease were:—

(1) *Epigastric uneasiness or pain* was present in 35 out of 38 cases of hyperchlorhydria.

(2) *Loss of weight and feeling of sickness* was present in 10 out of 12 cases of achlorhydria.

*Radiological findings*

The radiological findings of 38 cases of hyperchlorhydria in this series revealed that enlarged stomach with normal motility was present in 33 cases, pyloro-spasm in 21, abnormal duodenal cap in 28 and duodenal ulcer in 1 case. Spasticity of the colon, especially of the descending portion, was found in 32 cases, of transverse portion in 18 and of ascending portion in 7 cases. Hyperchlorhydria was present in all these cases. In all the 12 cases of achlorhydria the stomach was found to be dilated, toneless and ptosed. There was also ptosis of the transverse colon and splenic flexure. The exit of the barium meal was prolonged over 48 hours.

*Discussion*

The state of gastric acidity of one hundred correctly diagnosed cases of chronic ulcerative colitis has been studied. It was observed that the figures of gastric acidity obtained are definitely higher than those occurring in normal individuals. In 67 per cent of cases the gastric acidity was found to be definitely on the high side. The occurrence of excessive acid secretion in such a large proportion of cases of ulcerative colitis is difficult to interpret. It may be due to the reflex stimulation of the Meissner's plexus in the submucous coat of the stomach during the passage of food materials over the ulcerated surface of the colon. It may also possibly be due to the formation of a histamin-like substance by the proteolytic action of the bacterial flora of the intestine and its absorption into the circulation. The H-substance which is a secretory stimulant both for the peptic and salivary glands would provoke hypersecretion of gastric juice. These are some of the hypotheses which need to be substantiated by further experimental work.

The same difficulty arises in explaining the presence of achlorhydria in 12 per cent of cases of our series. We know that according to Hurst (1937) the incidence of physiological achlorhydria is 4 per cent at the age of 20 years (Bennet and Ryle), 8 per cent between 30 and 39 years and 12 per cent between 40 and 49 years. In the next three decades there is a further rise of only about 4 per cent. The ages of achlorhydria cases in this series were between 30 and 50 years. Whether the incidence of achlorhydria in these people falls within the

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## CHEMOTHERAPY IN BACILLARY DYSENTERY

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O'BRIEN (1940) reported the striking effects of sulphanilamide on Flexner and Sonne infections in laboratory animals. Similar experiments with Shiga infections were disappointing in their results.

Every practitioner in this country is frequently faced with the problem of treating those distressing cases labelled 'chronic bacillary dysentery'. His efforts are occasionally successful, but the more usual experience—and that in spite of a tiresome régime of successive treatments—is increasing anasarca progressing to œdema and death. At the time of reading O'Brien's remarks I had several such cases on hand and resolved to try chemotherapy on them. They were treated with sulphanilamide; some of them cleared up within seven to fourteen days and others showed no improvement. These resistant cases were then given sulphapyridine (M.&B. 693) and they all cleared up within four or five days.

It appeared from these observations that:—

1. Sulphanilamide is effective against some of the organisms of bacillary dysentery.
2. Sulphapyridine is more effective than sulphanilamide and, that, on organisms against which sulphanilamide is ineffective.
3. A clinical trial of these drugs on a large scale would be well worth while.

Not having facilities for the bacteriological typing of individual infections, I decided to conduct a trial by comparing the results of chemotherapy with those obtained by other methods of treatment. A total of 144 cases have been the subject of this comparison experiment; most of them arose on one estate as a

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above category or is the result of gastritis is a suggestion for consideration.

*Conclusions*

1. Hyperacidity commonly occurs in chronic ulcerative colitis.
2. The gastric symptoms in this disease are due to the anomaly of the gastric secretion.

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result of a large influx of casual labour to a P.W.D. undertaking.

In all cases the stools were microscopically suggestive of bacillary dysentery and the majority were, clinically, Shiga infections. As will be seen this is a supposition borne out by the relatively high death rates with treatments other than sulphapyridine. Some cases were admitted early in the disease, while others had been ill for several days and were brought to hospital when moribund.

*Treatment.*—Cases were put on to one of the following treatments:—

1. Polyvalent anti-dysenteric serum.
2. Sodium sulphate.
3. Sulphapyridine.
4. Sulphanilamide.

Selection of treatment was casual, except that cases admitted within 72 hours of the onset of the disease were given either serum or chemotherapy. Later cases were given saline or chemotherapy. The use of sulphanilamide was discontinued after 19 cases had been treated, as not being sufficiently effective.

*Serum treatment.*—The smallest dose of serum used was 40 c.c. Some cases received over 100 c.c. The intravenous route was used wherever possible and, if necessary, glucose-saline was administered at the same time.

*Sulphapyridine treatment.*—The dosage of this drug varied. In general, it appeared that the rapidity with which one might expect an effectual response varied directly as the size of the dose. The smallest effective dose used was 3 grammes (6 tablets) in two days in what appeared to be a mild case. The average case appeared to need from 16 to 30 tablets to effect a cure. Administration was started with a large dose—4 tablets—and continued thereafter with 2 tablets three hourly until the general symptoms subsided. In two cases the injection method of treatment described by Bryant and Fairman (1940) was tried, but the results were not satisfactory: this was also observed when the tablets were given whole and not crushed and suspended in water.

#### *Summary of results obtained with different treatments*

| Treatment         | Number of cases | Deaths | Deaths, per cent |
|-------------------|-----------------|--------|------------------|
| Serum .. ..       | 38              | 2      | 5.3              |
| Saline .. ..      | 31              | 9      | 29.0             |
| Sulphanilamide .. | 19              | 4      | 21.0             |
| Sulphapyridine .. | 56              | 1      | 1.8              |

From these figures it is obvious that sulphapyridine is an effective treatment for bacillary dysentery.

The death occurring under treatment with sulphapyridine was that of a chronic case in a

marasmic child aged 2 years who was also suffering from malaria.

#### *Clinical effect of sulphapyridine on bacillary dysentery*

This can be best described by giving typical case histories.

*Case 1.*—An Ooria labourer, aged 22 years, suffering from constant motions containing blood, mucus and slough, was admitted to hospital on the third day of the disease. His temperature was 101.8°F. and the pulse weak and rapid.

*First day of treatment.*—Twelve tablets given. Stools reduced to five in the evening: temperature down to normal by evening.

*Second day of treatment.*—Eight tablets given. Stools 6. Character—watery and blood-stained with slight mucus only; much less offensive. No stool during the night of this day, and the patient slept well.

*Third day of treatment.*—Four tablets given. No more was given. Stools 2 only, containing blood and a trace of mucus.

*Sixth day of treatment.*—Stool normal.

*Case 2.*—A boy, aged 12 years, was admitted to hospital in a collapsed condition, pulse imperceptible and temperature below 96°F. Stools were innumerable and consisted of blood, mucus and slough. He had been ill in the lines for four days. General resuscitatory treatment and the administration of sulphapyridine were immediately commenced. He was given a total of 19 tablets: 6 on the first day, 5 on the second day and 4 on each of the two subsequent days. His general condition improved greatly and stools became much reduced; but they contained slough until the fourth day, and it was not until the ninth day that his stool was formed and normal. He was discharged on the 18th day after admission. Under any other form of treatment than with M.&B. 693 this child would have died.

*Case 3.*—This is the case of one of my assistant medical officers. I quote it because he was able to give an accurate subjective account of his experience and because the course taken by the disease in his case is typical of what happens in an acute case treated early with sulphapyridine.

His illness started one evening with a temperature of 104°F., diarrhoea, nausea and tenesmus. The stools contained blood and mucus and numbered 18. He started a course of bacteriophage. On the next day his stools were uncountable and the pain severe. His temperature was now 99°. I then saw him, stopped the bacteriophage and put him on to sulphapyridine. He had 25 tablets in all; 12 tablets the first day, 8 the second day and 5 on the third day. Describing the effects of this medication he said: 'It was marvellous; within 18 hours the stools had decreased and the pain gone. I slept that night. I had one stool on each of the next two days, slightly tinged with mucus. On the fourth day after taking M.&B. 693 my stool was normal and I went back to work'.

#### *Summary of experience in the treatment of bacillary dysentery with M.&B. 693*

1. Sulphapyridine appears to be specific against infections with bacillary dysentery.
2. It relieves the pain within 12 to 18 hours.
3. The stool becomes normal within three to seven days: in my cases the average time required for the appearance of a normal stool was 4.7 days.
4. Blood disappears from the stool first; the mucus persists longer.

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# A PECULIAR NEUROLOGICAL SEQUEL TO ADMINISTRATION OF 4 : 4'-DIAMIDINO-DIPHENYL-ETHYLENE (M.&B. 744)

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and

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4 : 4'-DIAMIDINO-DIPHENYL-ETHYLENE is one of the chemical compounds prepared by Dr. A. J. Ewins of Messrs. May and Baker that has been found very effective in the treatment of kala-azar by workers in different parts of the world. The drug was tried by Warrington Yorke (1940) on an Indian seaman suffering from kala-azar in Liverpool, by Napier and Sen (1940) in Calcutta, and by Kirk and Sati (1940) in the Sudan, in each instance with remarkable success. Other reports have followed and at present a report by the present writers and a colleague on the treatment of 98 cases of kala-azar is in preparation. Our total experience of the drug now amounts to over a hundred cases, as we have used it—with little success—in other forms of leishmaniasis.

Administration of this drug has not been absolutely free from unpleasant reactions; among these are a burning sensation all over the body, flushing of the face, transient difficulty in breathing, nausea, vomiting, epigastric distress, giddiness, palpitation, sweating and occasionally collapse.

The almost constant finding during and immediately after the first few injections of this drug has been a marked fall of blood pressure, both systolic and diastolic, the former to a greater extent than the latter. A drop of 20 to 40 mm. of mercury within a minute or two of the injection has been found in all cases showing the more severe symptoms, and the drop has been even greater in the patients who collapsed. The blood pressure rises to nearly the previous level in almost all cases within 5 to 10 minutes and with this rise most of the symptoms disappear. In the cases in which there are serious reactions, an injection of adrenaline raises the blood pressure almost immediately and the unpleasant symptoms subside. When in such cases an injection of adrenaline is given a few

minutes before a subsequent injection, little or no fall of blood pressure takes place and the symptoms may be entirely absent.

The symptoms, giddiness, faintness, palpitation, sweating, epigastric distress and collapse, can be readily explained in most cases by this fall of blood pressure that results from the injection. If we regard the drug as having a histamine-like effect, the sudden fall of blood pressure and the symptoms associated with it, the flushing of the face, the hot sensation, the occasional burning sensation in the different parts of the body, and the dyspnoea can all be explained. The fact that adrenaline relieves these symptoms, also supports this point of view.

During the period that we have used this drug, four of our patients, one Bengali, two Hungarians, and one Anglo-Indian, have developed a peculiar neurological symptom-complex subsequent to their treatment with this drug. Had the symptoms appeared in one patient only, we would probably have overlooked the possibility of any connexion with this drug, but the fact that four patients all showed very similar symptoms a few months after the administration of this drug, led us to carry out general neurological investigations in these cases, and to write this note.

Case 1.—Bengali business man, aged 34 years, was admitted on the 16th April, 1941. He said he had kala-azar in 1924 for which he was treated with organic antimonials intravenously. The patient came complaining of irregular attacks of fever for seven months and nodular eruptions over the face for 1½ years. On admission, the spleen was found to be enlarged down to 5½ inches below the costal margin, measured from the tip of the 9th rib, and the liver was enlarged 1½ inches below the costal margin. He had the nodular type of dermal leishmaniasis on his chin and nose. The aldehyde test was positive and the spleen puncture smear showed *Leishmania donovani*. Smears made from snippings from the dermal nodules also showed leishmania. The patient was treated with a course of 4 : 4'-diamidino-diphenyl-ethylene (M.&B. 744), 15 intravenous injections were given from 28th April to 12th May, 1941; the total dose was 1535 grammes.

The patient was discharged from the hospital on 10th June, 1941, apparently cured of kala-azar. He was afebrile, the hæmoglobin had risen from 9.9 gm. per cent to 14.02 gm. per cent, the spleen was reducible under the costal margin, and he had put on 5 lb. in weight. The dermal lesions were unaffected and he was advised to attend the outpatient department for treatment of the dermal condition.

He was seen again in October 1941. He complained that since August 1941, he had been suffering from numbness and partial anaesthesia over his forehead, that exposure to the sun's rays for a time caused a burning sensation, that he had an intense sensation of cold when a slightly cold object came in contact with his forehead and cheek, and that shaving was quite painful (hyperaesthesia to temperature and touch). The trouble started as a sense of impairment of sensation over the upper lip, nose and forehead.

On examination.—He was found to be in good health, but the nodules of dermal leishmaniasis persisted unaltered on his chin and nose. The nose and the throat were apparently normal, the teeth and gums showed evidence of pyorrhoea, and there was tartar present. No abnormality was noticed in the heart or lungs. The liver was not palpable and the spleen was just palpable on deep inspiration.

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5. The earlier in the disease the sulphapyridine treatment is started the quicker the response.

6. The period of hospitalization was 30 per cent less than that with the next most efficient form of treatment—i.e., serum.

7. It is relatively cheap: the most I spent on any one case was Rs. 3 as compared with Rs. 4 to Rs. 14 for serum treatment.

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There was no abnormality in the cranial nerves I, II, III, IV, VI, VII, VIII, IX, X, XI, XII, or in the motor part of V. There was a loss of sensation to light touch over the forehead, nose, and part of the cheek. Perception of deep pressure and pain were unimpaired. There was no tenderness of the branches of the Vth nerve on pressure. The motor functions were normal and there was no disturbance of sensory functions elsewhere. The visceral reflexes were unimpaired and there was no vasomotor disturbance or trophic change. Superficial and deep reflexes were equal and normal on both sides.

There are two other points of special interest in this case, namely, that it is one of the very few apparently authentic cases of re-infection, and that it is an instance, equally rare, of the co-existence of a visceral and a dermal infection with *Leishmania donovani*.

In a not inconsiderable experience, the senior writer has only encountered one other case in which there was any real evidence of a re-infection occurring—a child who had been treated a year previously in his own wards as a very early case of kala-azar, diagnosed by cultural

Subsequent to his discharge from the hospital he attended the outpatients' department on several occasions and the splenic enlargement steadily decreased and the general health improved.

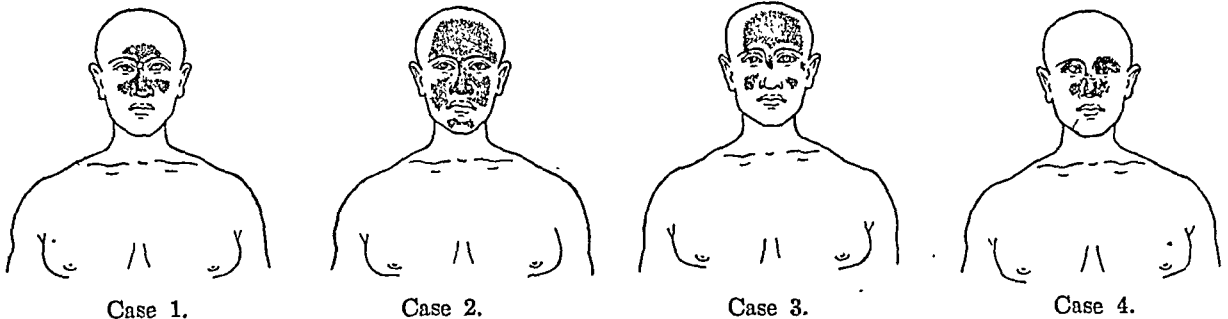
In May 1941, the patient experienced a sense of heaviness over the forehead and face, and this part seemed to be somewhat reddish in colour. Three weeks later he developed loss of sensation over this area. He was investigated at a general hospital and two of his teeth were removed; no abnormality was detected in his nose or sinuses. He had various treatments for this condition without benefit.

He was seen again in November 1941. He was complaining of a sense of heaviness over his forehead, face, eyelids and nose. His upper lip felt 'swollen'.

He could not keep his eyes shut tightly, there was a blinking movement of the eyelids, and occasionally a spontaneous twitching of some of his face muscles drawing up the angles of the mouth. He also complained of an erythematous rash developing over the chin and the tip of the nose.

He looked quite healthy. There was an erythema over the tip of the nose and the chin (the question of very early dermal leishmaniasis arose).

*On examination.*—No abnormality was detected in his nose and nasal sinuses, the remaining teeth were apparently healthy. The heart and lungs were quite normal. Neither spleen nor liver was palpable. There was no



Anæsthesia to light touch with preservation of sensation to pain, temperature and pressure is shown by the stippled area.

An area of complete anæsthesia (case 4) is marked by a cross.

methods. In this case relapse was excluded by the clinical history and the serological tests. He has had many cases in which there was a history of treatment for kala-azar some years before, but the authenticity of the first diagnosis has always been in doubt.

Only one or two cases of the co-existence of a visceral and a dermal infection have been reported (these also must necessarily have been cases of re-infection or relapse of kala-azar).

*Case 2.*—A Hungarian business man, aged 40 years, was admitted on the 10th January, 1941, for repeated attacks of fever since May 1940. He was diagnosed as and treated for kala-azar in another hospital, where he had a full course of injections but without benefit. He was apparently a 'resistant case' of kala-azar. The spleen was enlarged down to 8 inches below the costal margin. The diagnosis was confirmed by a strongly positive aldehyde test and by the finding of numerous *Leishmania donovani* in the spleen puncture smear. The patient was treated with a course of M.&B. 744. Fifteen intravenous injections were given from the 13th January to 27th January; the initial dose was 0.03 gm., the maximum dose 0.18 gm. and the total dose 1.66 gm. No untoward reactions were noticed during the course of treatment. The patient left hospital on the 28th January; he was afebrile, the spleen was softer and now measured 6½ inches below the costal margin and the hæmoglobin had risen from 7.975 gm. per cent to 9.762 gm. per cent.

disturbance of function of the cranial nerves, I, II, III, IV, VI, VII (except for inability to keep the eyes shut tightly, the blinking movements, and twitching of some face muscles), VIII, IX, X, XI, XII, and motor part of the Vth cranial nerve. There was loss of sensation to light touch over the forehead, nose, upper eyelids, cheek, and part of the chin. There was perception of deep touch and pain as tested by a pin-point. There was no tenderness of any of the branches of the trigeminal nerve. Motor functions were normal all over and there was no impairment of sensation in any other part of the body. Superficial and deep reflexes were quite normal on both sides and there was no impairment of visceral reflexes or disturbance of the vasomotor system.

The neurological condition has shown little or no change in eight months since it was first noticed by the patient.

*Case 3.*—An Anglo-Indian engineer, aged 26 years, was admitted on the 9th January, 1941, for fever for two months. He had been a patient in the hospital in August 1940, suffering from kala-azar and had been treated with a course of injections of neostibosan. After discharge from the hospital he remained afebrile for a month or so and then the present attack of fever commenced. At first, the attacks came on at irregular intervals, but at about the time of admission to the hospital it came on daily with chill and rigor. On examination, he was found to have an enlargement of the spleen 6 inches below the costal margin. No other abnormality was detected. The diagnosis of 'resistant' kala-azar was confirmed by demonstration of numerous *Leishmania donovani* in a sternal puncture smear.

He was given a course of 15 injections of M.&B. 744, intravenously, from the 9th January, 1941. The total dose was 1.36 gm. He was discharged from the hospital on 3rd February, 1941, apparently doing well: he was afebrile, the spleen had gone down considerably (2½ inches below the costal margin), and the hæmoglobin had risen from 6.325 gm. per cent to 8.662 gm. per cent.

In May 1941, the patient experienced a sensation like cramp in his upper lip. After about 3 weeks this symptom disappeared. Soon after, he felt a numbness first over the eyebrows, then it spread to the forehead and part of the face. Occasionally, he felt as if there was ice-cold water running down his neck. Since June 1941, he has often felt 'as if there were some worms running down the skin of his forehead' (formication) and this gave rise to itching, and was very disturbing. He had all his teeth extracted, and the nasal sinuses were attended to by a specialist.

He had injections of vitamin B<sub>1</sub> and some other treatments to no effect.

*On examination.*—The patient was apparently quite healthy. There was no detectable abnormality in his nose or throat. He had a complete set of false teeth. There was no abnormality in the heart or the lungs. Neither liver nor spleen was palpable. There was no disturbance of function of the cranial nerves, I, II, III, IV, VI, VII, VIII, IX, X, XI, and XII, or of the motor part of the Vth nerve. There was a loss of sensation to light touch over the forehead and anterior one-third of the head (a light touch to the hair over this was not felt), root of the nose, part of the cheek and right upper eyelid. There was some impairment of sensation to heat but not to cold over the forehead. The sensation of pain and deep touch were unimpaired. There was no tenderness of any of the branches of the Vth nerve. Motor functions were normal all over the body and there was no impairment of sensory functions over other parts of the body. Superficial and deep reflexes were equal and normal on both sides and there was no impairment of visceral reflexes or of the vasomotor system.

There has been little change in the symptoms during the last six months.

*Case 4.*—A Hungarian student, aged 15 years, was admitted on the 11th August, 1941, for intermittent fever for one month. On admission, the patient had an enlargement of the spleen 5½ inches below the tip of the 9th costal cartilage and the liver was palpable on inspiration. There was no other obvious abnormality. On investigation the aldehyde test was positive, and *Leishmania donovani* were found in the sternal puncture smear. The patient was treated with a course of 10 injections of M.&B. 744, from 12th to 21st August. The total dose was 0.96 gm. and the maximum single dose was 0.12 gm. The temperature came down to normal during the course of the injections. The patient was given a course of crinodora (atebrin-like compound), 1 tablet *t.d.s.* for five days, for giardia infection, and was discharged on 1st September, 1941. The spleen was greatly reduced, being just palpable on inspiration, at the time he left hospital.

He was seen again on 27th December, 1941. He complained of impairment of sensation and a sense of numbness over his face, a symptom he noticed whilst washing his face about a month before. He also complained of anæsthesia over his nose for about 3 or 4 weeks.

On examination the patient was found to be otherwise healthy. The throat was slightly congested, the tonsils had been removed two years previously and there was one 'filled' tooth, the rest being healthy. He had an attack of common cold, and the nasal mucous membrane looked congested. The heart and the lungs were quite normal. The liver and the spleen were not palpable. The left palpebral fissure was slightly wider than the right, but this condition had been present since childhood.

Neurological examination failed to reveal any abnormality in the cranial nerves I, II, III, IV, VI, VII, VIII, IX, X, XI, XII, and the motor part of V. There was anæsthesia to light touch over the areas indicated in case 4, with preservation of sensation of pain, pressure and temperature. In one small area (marked x) there was complete anæsthesia. There was some impairment of sensation over the scalp corresponding to the distribution of the ophthalmic division of the trigeminal nerve. He could feel similar light touch better over other areas of the scalp than over this part. There was no marked tenderness of the main branches of the trigeminal nerve on pressure. The motor function was unimpaired and the superficial and deep reflexes equal and normal on the two sides. The sensory function, visceral reflexes and vasomotor system were quite normal.

*Discussion.*—The salient features of the above four cases are: (1) Subjective disturbance of sensation over various parts of the trigeminal area, paræsthesia, anæsthesia, formication, and hyperæsthesia. (2) Loss of sensation of light touch over this area, with the preservation of sense of pressure and pain (dissociated anæsthesia). (3) No evidence of other neurological or any systemic disorder.

The fact that there is evidence of loss of function of the sensory part of the nerve rules out the possibility of trigeminal neuralgia. The affected areas do not coincide with the whole of the distribution of any of the branches of the 5th nerve and the dissociated anæsthesia and lack of trophic changes preclude the lesion being of the nature of peripheral neuritis.

Syringobulbia and thrombosis of the posterior inferior cerebellar artery give rise to lesions involving the medulla and the upper cervical segments of the spinal cord, and these by injuring the spinal tract and its nucleus will cause analgesia and thermo-anæsthesia, with preservation of sensibility to light touch. But in our cases, the conditions were exactly the opposite.

The following quotation from Russell Brain (1933) would appear relevant: 'Owing to the divergence of the sensory fibres of the trigeminal nerve within the brain stem, dissociation of sensibility over the face commonly results from central lesions. A lesion of the pons which involves the principal sensory nucleus will cause anæsthesia to light touch over the trigeminal distribution, with preservation of appreciation of pain, heat and cold'.

It would thus appear that the site of the lesion in these cases is in the pons, affecting the chief sensory nucleus. It is not possible to be dogmatic as to the nature of this lesion; it is possibly a toxic degenerative condition.

The slight weakness of the orbicularis oculi and occasional twitching of face muscles in case 2 are possibly due to irritation of the nucleus of the VIIth nerve which is situated in the pons.

The next question that arises is whether diamidino-diphenyl-ethylene can be regarded as the cause of this lesion. In this connexion, we must emphasize that there has been a complete absence of similar symptoms following any other

form of treatment for kala-azar, or in untreated cases of kala-azar, in the senior writer's experience of the disease in India.

The symptoms appeared a short period (3 to 4 months) after the cessation of treatment with this drug, in no case could any other cause be found, and the syndrome is entirely unlike any of the recognized diseases of the nervous system; the drug is, therefore, undoubtedly incriminated as the toxic agent causing this neuropathy.

This appears to be a particularly good example of the selective action of a drug on one particular part of the central nervous system. There are other examples of this selective action, *e.g.*, wrist drop in lead poisoning, though in this case the action is less specific. Trichlorethylene inhalation in industry is reported to produce bi-lateral loss of sensation confined to the distribution of the trigeminal nerve, a condition which is suggestively similar to the one we are describing.

The facts that the symptoms were noticed by the more intelligent patients and that these four cases constitute a considerable proportion of the patients we have examined subsequent to the course of treatment by this drug, suggest that this neuropathy may have been more frequent than this report on only four cases would appear to indicate, and careful enquiries should be undertaken to ascertain whether similar symptoms have occurred in patients treated in other parts of the world.

On the other hand, three out of four were 'resistant' cases and therefore a larger total dose was given than would be given to a previously untreated patient.

**Prognosis.**—Two of these four patients (cases 2 and 3) were under observation for some months and the condition did not seem to progress during this time. On the other hand, some of the patients suggested that the area involved was greater when they first noticed the condition than at the time of examination. We are probably justified in inferring that the condition is not progressive and that there is a tendency to spontaneous cure.

#### Summary

1. Four cases of kala-azar, treated with 4:4'-diamidino-diphenyl-ethylene, developed anaesthesia to light touch over the trigeminal area with preservation of sensation of pain, temperature and pressure.

2. The lesion is apparently in the pons, involving the principal sensory nucleus of the trigeminal nerve, and is possibly a toxic degenerative condition.

3. 4:4'-diamidino-diphenyl-ethylene is probably the toxic factor responsible.

4. The lesion is not progressive and its symptoms do not cause much physical discomfort. It would appear that the condition

(Concluded at foot of next column)

## USES OF TESTOSTERONE PROPIONATE : A REVIEW TOGETHER WITH SHORT REPORTS ON ITS USE IN SENILE PRURITUS AND SENILE ARTHRITIS IN MALES

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TESTOSTERONE PROPIONATE, the synthetic male sex hormone, is a potent therapeutic agent in the treatment of certain male and female disorders. It was first isolated from bulls' testes and later synthetically from cholesterol. It has been used clinically with marked success by many workers. In spite, however, of the fact that much has been written about it in recent years, the literature on male sex hormone as applied to various clinical conditions is still far from complete. Thus far, no clear-cut understanding as to the indications for therapeutic use of the hormone has been established. What is more important, the dangers of its indiscriminate use are apparently not realized by those who use it.

The following indications for the use of testosterone propionate are briefly considered :—

#### A. In males

1. Eunuchism, Eunuchoidism, Hypogonadism.
2. Cryptorchidism.
3. Male climacteric.
4. Premature senility.
5. Senile pruritus in males.

(Continued from previous column)

improves with time, as is the case in many other toxic affections.

5. One of the cases reported was incidentally a rare instance of the co-existence of dermal and visceral lesions of leishmania infection.

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**Postscript.**—We have since seen three more patients, two Bengalee males and one Anglo-Indian female, who have developed similar dissociated anaesthesia over the trigeminal area. In the Anglo-Indian female patient there was dissociated anaesthesia also over both sides of the neck corresponding to areas supplied by the cutaneous branches of the posterior roots of the third cervical nerves of the spinal cord. It is probable that in this case the lesion had spread to some fibres of the lemniscus which are situated close to the sensory nucleus of the trigeminal nerve in the pons.

The observation of these further cases adds weight to our suggestion that this sequel to the use of diamidino-stilbene may be much more common than we first believed.

6. Impotence.
7. Male infertility and defective spermatogenesis.
8. Benign prostatic hypertrophy.
9. As a 'tonic'.
10. Degenerative or senile arthritis.

#### B. In females

1. Chronic mastitis.
2. Menorrhagia.
3. Pre-menopausal uterine bleeding.
4. Uterine fibromata.
5. Dysmenorrhœa.
6. Precocious sexual maturity.
7. Frigidity.
8. Continuation of pregnancy beyond term.
9. Inhibition of lactation.
10. Otosclerosis in the female.

#### A. In males

*Eunuchism and eunuchoidism.*—A eunuch is a castrated male; the operation is performed before puberty. Sometimes trauma or disease necessitates a bilateral orchidectomy in later life.

Eunuchoidism is not artificially produced; it arises from disease of the testicle, occurring not later than in early adolescence or from a congenital testicular hypoplasia. The clinical picture resembles that of eunuchism when the operation is performed before puberty. It is called primary eunuchoidism when it is associated with an essential hypogonadism and deficiency of the male sex hormone, and secondary eunuchoidism when it results from disease of the testicles. Inflammatory conditions such as mumps, typhoid, syphilis and tuberculosis, trauma, or new growth of the testicles may lead to a deficiency of secretion of the male sex hormone.

*Clinical features.*—The majority of the patients present themselves at the age of puberty because of failure to develop, but in some cases the main symptoms do not appear until the age of 30 years (delayed eunuchoidism). Eunuchoids have unbroken and high pitched voices and their facial and body hair is either very scanty or absent. The genitalia are invariably hypoplastic, with an infantile penis which is sometimes minute, and atrophic testicles, which, when properly descended, lie in a small and relatively unpigmented scrotum. The prostate and seminal vesicles are poorly developed and only rarely palpable *per rectum*. The pubic hair, if present at all, is of the female distribution with a straight upper border and without an upward v-shaped extension on to the abdomen. Sexual desire is usually slight, but some cases do get erections before coming for treatment. The height is generally above the average, on account of the failure of the epiphyses to unite at the usual time. Contrary to the popular belief all eunuchs are not obese, and the same applies to eunuchoids. There is a local increase in fat at the sites where it normally accumulates in the female such as over the hips, the breasts

and the mons veneris. Eunuchoids have often poor muscular development and their skin is of fine smooth texture. This delicate skin, while it assists in producing the youthful appearance which is characteristic of this condition, tends to wrinkle in later life. Most eunuchs are intelligent people and some are brilliant. There is also a proportion of cases which is sub-normal mentally, suffers from anxiety states or shows frank psychotic manifestations. The excretion of androgens in the urine is usually minimal.

*Therapy.*—Foss (1937) has made observations on a man of 38, whose testicles were removed on account of a shrapnel wound during the last war. Sexual function and libido were restored by administration of 100 to 140 mg. per week. Vilaret *et al.* treated a 21-year-old eunuchoid by daily injections of 10 to 30 mg. of testosterone propionate. There resulted a marked development of the genitals, the face assumed a more manly appearance, the voice broke, there was a growth of hair and an increase in weight and muscular development. Kenyon (1938) treated 4 cases with 25 mg. daily for periods varying from 28 to 99 days. All had an increase in the number of erections and the size of the prostate, there was a marked increase in the size of penis and in the amount of the body and facial hair, and in 2, there was a deepening of the voice. Vest and Howard (1938) obtained similar results in 6 patients. There was a growth of the penis scrotum and prostate, the voice deepened and the pubic hair appeared. There were also ejaculations, libido and potentia in one case when none had existed before.

McCullagh (1939) reported on the urinary excretion of androgens in normal males, in cases of testicular deficiency and after injections of androgens. In normal persons, the average number of bird units of urinary androgen were 30; the highest and the lowest figures were 72 and 16 bird units respectively. In prepuberal hypogonadism of the adults the figures for urinary androgen were extremely low. McCullagh selected 6 cases of prepuberal hypogonadism and treated them for several months with gonadotropic hormone, pregnancy urine extracts, pituitary extracts or a combination of these. There was no rise in the urinary androgens, nor any symptomatic nor anatomical improvement. With injections of testosterone there was some penile growth, a questionable increase in the axillary and pubic hair and some penile erections. Injections of testosterone propionate 10 mg. twice weekly were then commenced. The level of the urinary androgens rose rapidly and symptomatic and anatomical changes followed in approximately the following order: penile erections occurred promptly and there was an increase in the pubic and axillary hair. The penis grew markedly and the scrotum less so, and the prostate growth appeared to lag perceptibly in proportion. There was no consistent evidence of increased testicular size,

although the testes appeared to be larger after treatment in one case. Nocturnal emissions occurred and the quantity of semen increased. No diminution in sperm count or inhibition of sperm production was obvious where sperms were present, though this may not be so where there is a normal number of spermatozoa before therapy. The larynx grew in size and the voice became lower. The appearance changed from juvenile to adult type and the face showed acne and growth of the beard. Epiphyseal closure did not exceed its expected normal rate.

*Dosage and methods of administration.*—The question of dosage must be decided for each individual case, but 25 or 50 mg. of testosterone propionate intramuscularly twice weekly are suitable doses with which to commence treatment. If no improvement occurs injections should be continued for a minimum period of three months before they are considered to be useless. The mode of administration recommended is by intramuscular injections but the hormone can also be given percutaneously by inunction, by mouth in the form of methyl testosterone (Finkler and Cohn, 1941) or by the subcutaneous implantation of a tablet from which slow and continuous absorption can take place.

Richardson recommends that after giving testosterone propionate for some weeks a course of gonadotropic hormones may be begun to stimulate the testes. Serogan (B.D.H.) or antostab (Boots) in an attempt to stimulate spermatogenesis and gonan (B.D.H.) or pregnyl (Organon) to stimulate the interstitial cells to produce their own male sex hormone.

*Cryptorchidism.*—Hamilton induced testicular descent in 9 immature macaque monkeys—normally cryptorchid until puberty—within 14 days by injections of testosterone propionate.

Bleriot treated 9 cases of cryptorchidism in boys by injections of 5 to 10 mg. of perandren (Ciba) twice weekly. Descent of the testes usually occurred after a total of 100 to 150 mg. Grignon induced descent of the testes in a cryptorchid of 13 years of age, after 15 injections of perandren. Bishop considers that cryptorchidism is more successfully treated by gonadotropic therapy, though Hamilton prefers male hormone therapy because its action is independent of a functional testis, and because the effects thereof are less widespread throughout the body.

*Male climacteric.*—Werner, discussing the male climacteric, states that 'an endocrine dysfunction plus the imbalance of equilibrium between the two divisions of the autonomic nervous system with the evidence at times of disturbance in the psychic centres is due primarily to the decline of the sex glands'. He reports 2 cases. One patient complained of nervousness, mental depression and hot flushes which occurred about three times a month and lasted an hour. The patient also gave a history of vertigo, numbness

and tingling of the extremities, palpitation, breathlessness, fatigability and headache. He was given injections of 10 mg. perandren three times a week. The results were very impressive but the symptoms returned with discontinuance of the therapy. The second patient was a partial castrate, with atrophy of the remaining testicle. The symptoms were classical. After treatment with 10 mg. of perandren three times a week the patient seemed much improved and his symptoms had disappeared. McCullagh (1939) records the case of a man aged 58, complaining of irritability, excitability and melancholia and almost complete impotence. The urinary androgen content was very low—3 units. Injections of testosterone propionate 2.5 mg. on alternate days were commenced two and a half years after the onset of symptoms. In about two weeks he was sexually normal with great diminution in the sense of melancholy and irritability. The dose of testosterone was increased to 10 mg. on alternate days and the treatment was continued for 16 months. Sexual potency remained normal on cessation of treatment.

These results have been amply confirmed by workers from different parts of the world.

*Senile pruritus in the male.*—On 15th January, 1940, a male aged 54, suffering from otosclerosis, presented himself in the writer's office. It was decided to treat his deafness with injections of the follicular ovarian hormone. Injections of menformon were therefore commenced. After the fourth injection the patient developed tremor of the extremities and mild symptoms of depression. No great significance was attached to these as the patient's hearing began to improve. After the sixth injection his hearing was definitely better, but he had developed symptoms of a profound involutional psychosis. He had also intolerable itching all over the body.

Injections of testosterone propionate 25 mg. (twice weekly) were then commenced. After a course of 12 injections his mental symptoms were definitely improved and his pruritus had disappeared.

Five more cases of idiopathic general pruritus have since been treated by the writer by injections of testosterone propionate. Three of these cases were in males over the age of 50 years. One patient was an old woman aged 63. The remaining patient was a young man aged 27. Definite improvement was manifested in all the three elderly men patients after six injections of 25 mg. of testosterone propionate. In 2 the pruritus totally disappeared after ten injections and in the third there was a relapse after discontinuation of the treatment. This was, however, controlled by further injections of 10 mg. twice weekly. After three months' treatment with testosterone propionate pruritus disappeared in this patient as well. In the remaining 2 patients—the old woman of 63

and the young man—there was no change in the condition at all, even after a dozen injections of the drug.

Though the number of cases treated is too small to draw definite conclusions it appears that senile pruritus in men is in some way related to a failure of the male sex hormone. This consideration is strengthened by the fact that treatment with male sex hormone succeeded only in old males and had no effect in both the other patients.

*Impotence.*—Sexual impotence in the male may be due to one or more of the following causes: (1) psychic disturbances, which are commonest and most difficult to treat; (2) organic disease of the nervous system, which is usually overshadowed by other manifestations; (3) local lesions of the genitalia, which are unimportant numerically and easily recognized, and (4) disorders originating from disturbances of the endocrine glands.

Huhner (1939) reported 7 cases of impotence successfully treated with injections of 10 to 25 mg. of testosterone propionate given two or three times a week. These results have, however, not been confirmed by Creevy and Rea, who treated 12 patients with impotence without evidence of hypogonadism, with testosterone propionate without any improvement in the impotence. Spence (1940) treated 6 patients with functional impotence unassociated with hypogonadism unsuccessfully and concludes that testosterone propionate has no effect on impotence due to psychological disturbances.

In the writer's opinion, benefit from treatment with testosterone propionate results only in those cases of impotence in which either the function is poorly developed or fails during later life. In all these cases the urinary androgen content is low and is raised by injections of testosterone propionate. When improvement follows the use of testosterone propionate in cases of psychic impotence, invariably evidence of hypogonadism is also present. In purely psychic cases of impotence increase of libido or sexual desire does not follow the use of the male sex hormone.

*Male infertility and defective spermatogenesis.*—It is generally agreed that gonadotropic therapy is more suited to this condition than injections of male hormone. Rubinstein, however, reported initiation of spermatogenesis in an adult hypogonad patient following treatment with testosterone propionate. Rubinstein and Kurland treated 8 normal adult males with 5 mg. perandren injected intramuscularly three times in a week. There was increase of spermatozoal counts in all. Increasing the dosage to 25 mg. per injection in the normal adult led to a depression of the count. Whether counts were raised or depressed during therapy, cessation of treatment soon led to a return of normal figures. McCullagh (1939) was unable to find

any evidence of oligospermia in the series of cases treated by him. Heckel (1940) treated 15 patients with testosterone propionate. Of these 10 had normal spermatozoa counts, 2 had moderate oligospermia, and 3 had an extreme oligospermia of undetermined cause, before treatment was commenced. Ten of the 12 patients, including the 2 that had a moderate oligospermia, showed a great depletion of spermatozoa as a result of the treatment. In 2 patients no great change occurred in the number of spermatozoa.

Of the 3 patients who had a marked oligospermia before treatment, 2 showed a slight temporary increase in the number of spermatozoa after injections of testosterone propionate, and the sperm count of the other one showed no remarkable change. Heckel considers that in patients of such marked oligospermia more information is needed before definite conclusions can be drawn concerning the influence of this material upon spermatogenesis. It is logical to see how the androgens might increase spermatogenesis in these patients if the cause is from a deficiency of testicular hormone.

Promiscuous use of testosterone propionate in persons with normal testicular function is to be deprecated.

*Benign prostatic hypertrophy.*—There is considerable evidence to show that the male sex hormone can arrest the changes produced in the prostate of immature experimental monkeys by injections of oestrone in an oily solution. For this reason male sex hormone has been advocated in the treatment of benign prostate hypertrophy. Heckel (1940) reports a series of 22 patients in whom there was no clinical improvement following treatment with much larger than the conventional doses of testosterone propionate. Heckel also failed to observe any histological changes in the prostates of those treated by testosterone propionate from those not so treated. Sharpey-Schafer and Shackman, though they failed to find any significant histological change in the hypertrophied prostate of a patient who had received large doses of testosterone propionate, report that the prostate was macroscopically reduced to about one-third of its former size. Draper, Slaughter and Denslow (1941) recently treated 9 cases by alternate courses of injections of testosterone and of saline. Five showed marked improvement when treated with saline or testosterone. These authors conclude that there was no apparent improvement in the urinary status of these patients resulting from injections of testosterone which could not be duplicated by injection of sterile saline. As most of the criteria of response, such as frequency of micturition, are subjective and the symptoms notoriously subject to exacerbation and subsequent relief, it is difficult to evaluate the results of endocrine therapy. The dose recommended is 5 to 25 mg. intramuscularly two or three times a week.



The author has recently used testosterone propionate in 3 cases of degenerative arthritis in men. In 2 out of 3 patients, there was both subjective and objective improvement. The swelling and the stiffness were diminished and the pain greatly ameliorated after the sixth injection of 25 mg. in one case and after the ninth injection in the second. Maintenance doses of 10 mg. are now being given to these patients for the last three months. In addition to the improvement in the joint symptoms both the patients report a sense of general well-being after the institution of treatment. The third patient, while he was less depressed mentally and thought his spirits were better, had no improvement in the joint symptoms. While no conclusions can be drawn from 3 cases only, the results appear to be sufficiently encouraging to warrant further trial of its use in this extremely difficult and refractory disease.

*As a tonic.*—Its use as a tonic, except where there is evidence of lack of development of testicular function or its failure in later life, is devoid of any scientific support.

### B. In females

*Chronic mastitis.*—Loeser (1938, 1940) and Spence have reported successfully on the use of testosterone propionate in the treatment of chronic mastitis. These results have been generally confirmed by other workers.

The condition is characterized by pain and by nodular swelling of the breasts. A number of cases show microscopical evidence of epithelial proliferation, increase in number and cavitation of ducts and alveoli, and in the amount and nucleation of fibrous tissue. A similar histological picture is seen after prolonged therapy with large doses of oestrogens. The condition regresses on administration of androgens. The dosage recommended is 25 mg. intramuscularly twice weekly for a few weeks. As the treatment may be attended with certain undesirable manifestations such as growth of hair on the upper lip, deepening of the voice and enlargement of the clitoris, great care must be exercised in its use.

Spence (1940) has recently used local injections of an ointment of testosterone propionate in doses of 3 to 10 mg. daily, and reports excellent results from its use in the treatment of 8 patients with chronic mastitis; no undesirable results in the way of masculinization were encountered. Moreover the inconvenience of injections is avoided and the treatment is much cheaper.

*Menorrhagia.*—Zuckerman (1937) showed that injections of testosterone propionate in mature rhesus monkeys will succeed in arresting the menstrual cycle. He further showed that the cycle recurred normally on cessation of

medication. Loeser (1938, 1940) used it successfully in a number of cases of menorrhagia. He thought that suitable doses could be used to induce atrophy of a normally functioning endometrium, or even of an endometrium in a pathological state resulting from too much oestrogenic stimulation. This action could be explained by supposing that it prevents the ovarian follicle from ripening by inhibition of the gonadotropic hormone. Mukherjee (1940) treated 9 cases of metropathia hæmorrhagica with encouraging results. Moderate cases of metropathic hæmorrhage were treated with 10 mg. of testosterone propionate by intramuscular injections every third day until the bleeding had stopped. Five milligrammes of the substance were then given twice weekly for two weeks and then once weekly for four weeks. The total dosage required was on an average 90 to 120 mg. Severe cases were treated essentially on the same lines, only bigger doses were employed. Thus the first two doses were 25 mg. each, while the subsequent dose was 10 mg. at each injection.

*Pre-menopausal uterine bleeding.*—Testosterone propionate has been used successfully for pre-menopausal uterine bleeding. The advantages claimed for it are:—

1. It obviates the need of applying radium or the use of x-ray, which is usually followed by severe climacteric symptoms.
2. It does not cause sudden and permanent amenorrhœa.
3. It does not require hospitalization and is therefore readily accepted by most patients.

Mazers treated 64 women, 48 of pre-menopausal age and 16 younger women with functional bleeding, with small doses of testosterone propionate intramuscularly every other day for one month. A total dosage of from 50 to 200 mg. given over a month was found to be effective and did not evoke any masculinizing changes.

*Uterine fibromata.*—There is no evidence, up to date, that injections of testosterone propionate have any definite value in the treatment of uterine fibroids. Loeser (1940) treated 5 patients with fibroids complicated by menorrhagia, by implantation of testosterone tablets. While the menorrhagia was beneficially affected, there was no effect on the fibroids.

*Dysmenorrhœa.*—Salmon, Giest and Walter treated 30 patients complaining of dysmenorrhœa, with injections of the male sex hormone. In 22 there was complete relief from pain, in 4 there was partial relief and in the remaining 4 there was no improvement. The dosage recommended is from 250 to 300 mg. of testosterone propionate during one cycle. In some cases the treatment was commenced during the first week; in others on the fifteenth or sixteenth day of the cycle. Rubinstein and Abarbanel treated 26 cases of dysmenorrhœa and found that, while the treatment was effective in



essential dysmenorrhœa, there was little or no benefit in organic or anatomically determined dysmenorrhœa.

*Precocious sexual maturity.*—Mukherjee (1940) treated a girl, aged 8 years, with enlargement of the breasts, growth of hair in the axillæ and on the pubis, and onset of menstruation, by injections of testosterone propionate 5 mg. twice a week. After a total of 85 mg. the vaginal bleeding stopped, the labia shrank in size and the hair grew sparse. One case is, however, insufficient to draw any conclusions and further work is necessary to arrive at a correct evaluation of this type of treatment in precocious sexual maturity.

*Frigidity.*—As the treatment is known to increase sexual desire in women, it may be used cautiously in the treatment of frigidity.

*Prolongation of pregnancy beyond term.*—Mukherjee (1940) after experiments on guinea-pigs treated one case in a human being. The result was encouraging. If it is confirmed by future work we will have in testosterone propionate a drug which will combat habitual premature birth.

*Inhibition of lactation.*—Mukherjee (1940) treated 18 patients in whom suppression of breast secretion was deemed necessary because of still-birth, neonatal deaths and in one instance tuberculosis of the mother. Complete inhibition of breast milk was obtained in 8 patients in whom the treatment was commenced on the day of the delivery. On the other hand in 6 cases, where testosterone was given on the third day or after, little or no immediate effect was obtained. It would appear that testosterone propionate has little action on the activity of the mammary glands once the secretion has commenced. In 4 nursing mothers inhibition of milk was required one to three weeks after confinement because of neonatal death. In all of them treatment was only partially satisfactory and complete suppression of milk was not possible in spite of intensive treatment.

For an average case the initial dose was 25 mg. followed by 10 mg. at an interval of two days and then further two to six injections of 5 mg. at intervals of four to six days.

*Otosclerosis in the female.*—Bernstien and Gillis (1939) treated 38 unselected cases of otosclerosis with injection of testosterone propionate; 5 to 10 mg. were injected at weekly intervals for a course of 10 to 12 injections. Out of 38 cases treated, 24 improved. The authors conclude that there is some intimate connexion between the gonadal internal secretions and otosclerosis. It may be that there is in otosclerosis an imbalance between the male and female sex hormones, and this can be rectified by the administration of the deficient hormone.

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## TYPHUS FEVER IN BURMA

(WITH RECORD OF THREE CASES)

By R. L. SONI, M.B., B.S., F.R.H.S.

KUNDU (1932) was the first to report typhus from Burma. The next year the second case came from Martin and Anderson (1933). These two cases stimulated investigation into the prevalence and distribution of typhus fevers in Burma. Maitra and Sen Gupta (1936) reporting the result of an investigation showed that 109 cases of typhus fevers distributed over 24 out of the 40 districts in the country were discovered during a period of two and a half years and that cases of 'scrub' and 'shop' typhus were seen to occur indiscriminately in rural and urban areas. Later, Kapila and Maitra (1937) reported a case of scrub typhus from Bhamo. No other cases have been reported from this country.

Our attention was first drawn to this fever in February 1935, when our clinical assistant (case 1) suffered from a continuous fever which on serological investigation was diagnosed as 'shop typhus'. This led us to investigate some of the similar cases seen within the three previous months and two out of these returned with a suggestion of typhus. Our second case occurred in 1936 and the third one in 1940. Brief notes from these three cases are given below :—

*Case 1.*—Clinical assistant, aged 24, complained of fever associated with severe headache and general aches and pains one evening. On examination, temperature was found to be 100°F., pulse 75 per minute full and regular, throat congested, eyes red and face flushed. The fever rose and continued, associated with relatively slow pulse, splitting headache, mental confusion and general restlessness. Bronchitis complicated the picture from the 3rd day and the patient complained of chilly sensation off and on. Blood films taken on the 5th day showed benign tertian malarial infection. Atebrin tablets were administered for 4 days: during this period the patient became delirious and noisy and he continued so for 5 days; on regaining consciousness he was apathetic. On the 10th day the temperature suddenly dropped to normal and he almost collapsed. Adrenalized glucose solution 50 c.cm. given intravenously resuscitated him. Temperature rose again

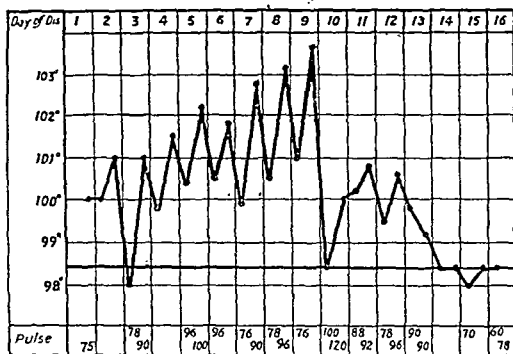
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and came to normal by lysis on the 14th day and thereafter remained normal. No rash was detected. Treatment was mostly symptomatic and convalescence rapid.

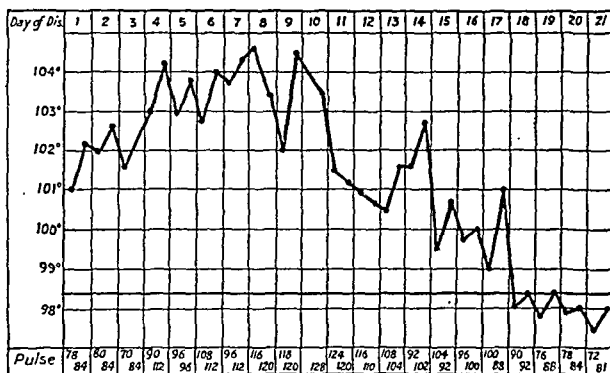
#### Case 1.



The patient was clean in his habits. No lice were detected on his person nor did he remember having been bitten by any insects, apart from mosquitoes, within a fortnight. However it may be noted that for 3 days, 10 days prior to the onset of fever, he had engineered and personally supervised an intensive rat drive.

**Case 2.**—Doctor, aged 33, was taken ill with slight shivering and severe dengue-like aches and pains. The temperature kept on rising and general restlessness became marked. On the 4th day, consciousness became dulled and towards evening the pulse was imperceptible but it improved with adrenalin administered intravenously. Retention of urine occurred during the 2 following days and the catheterized urine had a trace of albumin. Blood pressure at the time was 110 mm. Hg. systolic, 80 mm. Hg. diastolic. On the 6th day, a profuse rash, rather itchy, was noticed on the trunk and limbs, and the restlessness

#### Case 2.



became more marked. Heart, which had functional extra-systoles even in health, became more irregular the following day and towards evening the pulse again began to fail and unconsciousness supervened, but adrenalin once again set the condition right.

On the 8th day, in a semi-conscious condition, he was shifted to a hospital 70 miles south and 2 days later to Rangoon General Hospital, another 75 miles southward. Repeated examination of the blood showed no malarial parasites. Red cell count was 4,000,000 and leucocytes 4,000. The rash, quite diffuse on the back, had begun to fade by the 11th day. Treatment was mostly symptomatic.

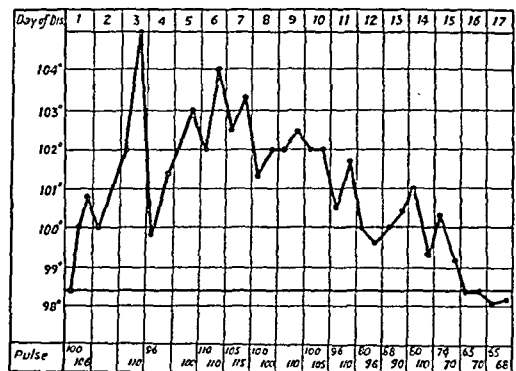
On the 18th day the temperature dropped to normal and remained so thereafter. But, as the heart resented movements, becoming irregular even on sitting, another five weeks had to be spent in bed. Quinidine in small doses was helpful. Apart from musculo-spiral neuralgia

(right side) which occurred at this stage the improvement was steady. Later, a change to the hills for a couple of months rapidly recuperated his health.

There were no lice on the patient, nor history of any special insect bite.

**Case 3.**—Female, aged 20 years, had a complete abortion in the third month and was feeling quite comfortable. Six days later she felt slightly indisposed: she had slight cold and temperature was 100°F. The next day she passed a large clot *per vaginam*. The temperature kept on rising and on the 3rd day it suddenly went up to 105°F. Vaginal examination revealed loaded rectum, profuse leucorrhœa unstained with blood, os closed and uterus in normal position though soft. An enema relieved her of pain in the lower part of abdomen. Urine was found free from albumin and blood examination revealed no malarial parasites. Hæmoglobin at this stage was 80 per cent. Though in view of the antecedent abortion attention was focused on the uterus, it was considered advisable to 'wait and watch' and avoid intervention for the time.

#### Case 3.



The next morning temperature dropped to 99.8°F. but rose again and followed a continuous course for another 12 days, by the end of which period it arrived at normal by lysis and remained normal after that.

A roseolar rash was noted on the trunk on the 6th day. The eruption was scanty and short-lived. There was no marked restlessness at any stage, abdominal reflexes were sluggish in the second week and towards the end of that week anemia was appreciable and hæmoglobin was found 45 per cent on the 14th day.

Prontosil album tablets orally and omnadin intramuscularly were used besides the symptomatic treatment. Toxaemia was not appreciable in this case, nor was there any mental confusion. In fact the patient was, except on the 3rd, 4th and 5th days of the disease, quite comfortable and cheerful throughout. To combat the rapidly developing anæmia she was put on liver extract and iron orally. Convalescence was rapid and uneventful.

To save space, additional information on the three cases is given in the appended table and temperature charts.

**Comments.**—The onset in the first two cases was marked by severe headache and distressing aches and pains in limbs and back, but in the third case there was only slight cold and indisposition to begin with. The toxæmia, restlessness, muscular prostration, mental confusion and delirium that followed were found to be in direct proportion to the initial aches and pains. The severity of these symptoms, however, appeared to have no relation to the height of temperature, for in the third case though temperature was high and sustained, these distressing symptoms were absent or extremely mild. Whether the comfortable course in the third case was due to the

mild onset or to the use of the prontosil album tablets it is hard to say. Omnadin was administered in the second and the third cases: it had practically no influence on the course of the second case: it is just possible it had no influence on the third even. If prontosil was responsible for the comfortable course in the third case, it was anyway definite that it had no appreciable influence on the temperature chart. Rather it could be held responsible for the anæmia that was noted to develop in that case following its use.

A study of the temperature charts is also of interest. All the three charts depict more or less continuous temperature interrupted by a sort of transient pseudo-crisis occurring a few days in advance of the actual termination by lysis or crisis. The pseudo-crisis was quite marked in case 1. Moreover in that case the undulations on the temperature chart from the 2nd to the

medical case could easily be mistaken for a serious obstetric emergency.

The rash was not a constant feature in these cases. It was profuse in case 2, mild in case 3 and absent in case 1. In none of the cases were lice detected, nor was there history elicited of any special insect bite for a fortnight preceding the onset. In case 1, the rat drive 10 days prior to the onset is of some interest. Goyal (1941) describes an enzootic of typhus fever in wild rats of Calcutta. Though the rat strain he worked with was considered non-pathogenic to man, it is just conceivable that there may be strains in rats of some localities pathogenic to men.

*Acknowledgments.*—Our thanks are due to the Pasteur Institute, Rangoon, for examining the sera for Widal and Weil-Felix tests, and also to the authorities of the Rangoon General Hospital

TABLE  
Results of laboratory investigations

| Case number | Day of disease when examination done | Widal tests                            | LABORATORY FINDINGS |         |                |            |                  |           |           | Additional notes  |
|-------------|--------------------------------------|--|---------------------|---------|----------------|------------|------------------|-----------|-----------|---|
|             |                                      |  | Urine               |         |                |            | Weil-Felix tests |           |           |   |
|             |                                      |  | Reaction            | Albumin | Russo reaction | Diazo test | OXK              | OX19      | OX2       |   |
| 1           | 5th ..                               | ..                                     | Ac.                 | —       | +              | —          | ..               | ..        | ..        | Malarial parasites also found.  |
|             | 12th ..                              | ..                                     | Ac.                 | ++      | +              | +          | ..               | ..        | ..        |   |
|             | 16th ..                              | ..                                     | Ac.                 | ++      | +              | +          | ..               | ..        | ..        |   |
|             | 18th ..                              | —                                      | ..                  | ..      | ..             | ..         | + 1 : 34         | + 1 : 340 | + 1 : 64  |   |
| 2           | 6th ..                               | ..                                     | Ac.                 | +       | +              | —          | ..               | ..        | ..        | Tenth day urine examination revealed epithelial cells, some pus cells, but no casts.                    |
|             | 8th ..                               | —                                      | Al.                 | ++      | ..             | ..         | — 1 : 50         | — 1 : 50  | — 1 : 50  |   |
|             | 10th ..                              | ..                                     | Ac.                 | +       | ..             | ..         | ..               | ..        | ..        |   |
|             | 14th ..                              | T + 1 : 600<br>TO + 1 : 100<br>A + B — | ..                  | ..      | ..             | ..         | + 1 : 30         | + 1 : 375 | + 1 : 750 |   |
| 3           | 4th ..                               | ..                                     | Ac.                 | —       | +              | —          | ..               | ..        | ..        | Hæmoglobin percentage on 6th day = 80 per cent.<br><br>Hæmoglobin percentage on 14th day = 45 per cent. |
|             | 6th ..                               | ..                                     | Ac.                 | —       | +              | —          | ..               | ..        | ..        |   |
|             | 10th ..                              | —                                      | ..                  | ..      | ..             | ..         | — 1 : 50         | + 1 : 300 | — 1 : 50  |   |
|             | 12th ..                              | ..                                     | Ac.                 | —       | —              | +          | ..               | ..        | ..        |   |

9th day are quite suggestive of the malaria complicating the picture. The acute peak, so very prominent in the temperature chart for case 3 on the 3rd day, may be due to some toxins released into the general circulation by the contraction of the uterus following the expulsion of the last remaining clot from its cavity.

It is also of interest to note that the abortion preceded the onset by 6 days in case 3; this was a serious trap to mislead diagnosis. A

for permission to use the hospital records of case 2.

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## BOILS AND CARBUNCLES: THEIR TREATMENT BY X-RAYS

By G. GHOSH, M.B., B.S., D.T.M.

*Röntgen Clinic, Allahabad*

THESE frequent and unwelcome visitors are always due to an infection. The greatest preventative is constant cleanliness. The back of the neck is the most frequent place, in men, for boils and carbuncles to occur, as in this situation the skin is coarse and ill-nourished and in some cases abrasions caused by a stiff collar encourage invasion by micro-organisms. Diabetes particularly predisposes to boils and carbuncles. Carbuncles are more frequent in old than in young men; they develop more often on the back of the neck than on any other part of the body.

Carbuncles and boils on the cheeks, upper lip and nose are particularly dangerous, owing to the risk of cavernous sinus thrombosis *via* the facial and ophthalmic veins, or the deep facial vein and the pterygoid plexus.

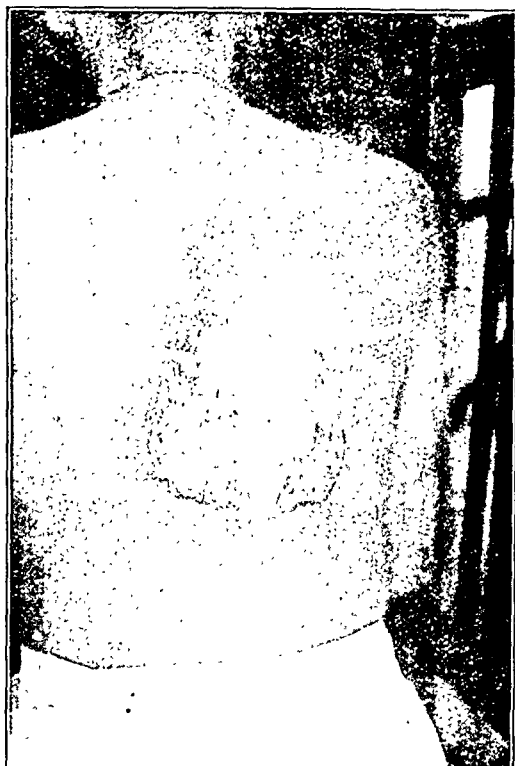


Fig. 1.

It is practically impossible in the beginning to determine in most instances that a patient has a carbuncle. An apparent boil may develop into several boils, with several openings, and become a carbuncle. The patient complains of tenderness and stiffness at the site of origin of the carbuncle. The subcutaneous tissues become painful and indurated, and the overlying skin is red. Gradual extension occurs and after a few days areas of softening appear.

The skin then gives way and thick pus and sloughs discharge. The condition sometimes extends widely, and fresh openings appear in the skin, and tend to coalesce with those previously formed.

### *Treatment*

Treatment consists, in the first place, in local cleanliness, improving the general resistance of the patient by means of tonics, fresh air, ultra-violet rays and vaccines.

Pusey and Ormsby consider *x-ray* therapy a very valuable method of treatment in recurrent furunculosis in circumscribed areas. Röntgen therapy gives such excellent results in carbuncles and boils that in my opinion it should be the treatment of choice, particularly in those which are considered bad surgical risks. The beneficial effect of irradiation on lesions of this character—furuncle, carbuncle, cellulitis, phlegmon or abscess of soft tissues—especially when treated early, before the stage of suppuration, has been demonstrated by many workers. It is surprising that the value of such a simple and

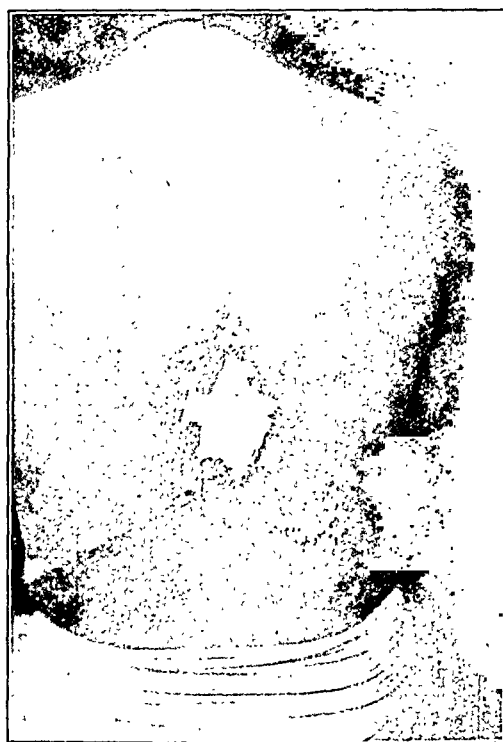


Fig. 2.

effective treatment is not generally realized by the profession.

The rapidity of improvement, the relief of pain and the abortion of the development and regression of the inflammatory process are all so striking and spectacular by *x-ray* treatment that they have to be seen to be believed. Prompt and marked benefit is derived in most cases. Pain is relieved in about 24 hours, but in a small percentage of cases this relief may be preceded by a temporary increase

in the pain. The treatment is most effective during the early stages when other methods of treatment are least effective; it is painless and inexpensive and does not interfere with a patient's activities; it often relieves pain in a few hours, makes hot or other dressings unnecessary, or shortens the period during which they must be applied; it often obviates an operation; and it yields a better cosmetic result.

The dose of  $x$ -ray should preferably be small, and usually a single exposure is sufficient. In cases which do not react promptly to the initial exposure, the treatment may have to be repeated at intervals, depending on the dose, which may vary between 25 and 75 per cent of an erythema skin dose. The quality of the rays should be graded according to the depth and thickness of the lesion. With such doses there should not be any skin or general systemic reaction; therefore, the treatment may be given to weak and febrile patients without danger. Irradiation



Fig. 3.

M.S. Case 374.—A case of carbuncle showing the result of  $x$ -ray treatment.

during the suppurative stage is less effective, but even then it may relieve pain and may shorten the course of the inflammatory process. Carbuncles treated in the early stages will rapidly localize, cease to extend and readily permit surgical drainage.

#### Technique

I have collected here some of the techniques adopted by various authorities and the results achieved by them, in treating boils and carbuncles.

In single boils and carbuncles MacKee and Niles claim to have obtained good results with a single dose of 230  $r$  of  $x$ -rays filtered with 3 mm. of aluminium. Goyle has obtained remarkable results by the use of intensive filtered radiations in carbuncles. Dunham obtained prompt cures in 11 cases of carbuncles with the same technique. Ruggles confirms Dunham's work, obtaining quick cures in both boils and carbuncles. Dunham has obtained excellent results with similar treatment in cases of streptococcal palmar abscess.

Leddy and Morton state that when a lesion is in the indurated stage before suppuration has set in,  $x$ -rays cause rapid regression in about 50 per cent of the cases and considerable relief in the remainder. They had 74 cases of boils and 26 cases of carbuncles. They found that boils responded much better and more rapidly than carbuncles. They used 135 kv., 4 mm. al. filter 16-inch distance, 5 ma. for 10 minutes for boils and the same factors for 15 to 18 minutes for carbuncles. They found that irradiation of affected areas prevents the infection of other follicles. Desjardins believes that radiotherapy may render surgery unnecessary and that small doses (10 to 15 per cent erythema dose) give the best results.

Baensch treated 103 cases of furuncle of the face with  $x$ -rays and the same number of cases with other measures. The mortality in the irradiated cases was 1.9 per cent and in the others 10.7 per cent. In a few hours after treatment, the pain stopped and the temperature fell. The time required for treatment was shortened and there were no recurrences in the treated area. His dosage was 150 to 250  $r$  filtered with 0.5 mm. zinc and 3 to 5 mm. of aluminium at 30 cm. focal distance.

Firor reported on 56 carbuncles treated with  $x$ -rays, in only one of which was excision required. He found that smaller doses were just as successful as large.

Hodges believes that in furuncles filtered  $x$ -rays give better results than small doses of unfiltered, low-voltage  $x$ -rays. He uses doses of 125  $r$  at 125 kv. filtered with 4 to 6 mm. of aluminium at 10 inches distance for several weekly treatments and with this method causes disappearance of existing furuncles and almost always aborts newly-forming ones. With carbuncles, on the other hand, he considers that small doses (100  $r$  at 85 kv.) of unfiltered rays for two or three treatments give the best results. Irradiation limits the spread of the lesion, lessens pain, increases drainage, shortens the course and lowers the mortality.

Meyer reports on 50 cases of furunculosis of the lip, which were treated with  $x$ -rays, without a failure or mishap. A single dose of 100 to 200  $r$  at 100 kv. was applied through a 1 to 5 mm. of aluminium filter and occasionally a second dose was given on the third day.

I have recorded here a series of 20 cases of carbuncles and boils treated by me during the

TABLE

*Record of cases of boils and carbuncles treated by x-rays at the Röntgen Clinic, Allahabad, during the last 2½ years*

| Register number | Name   | Age | Sex | Clinical history and findings  | Diagnosis  | Details of x-ray treatment   | Dates on which the treatments were given | Total number of sittings given in each case | Results   |
|-----------------|--------|-----|-----|--|--|--|--|---|---|
| 61              | M.P.   | 63  | M.  | Painful swelling of the whole of the right hand and wrist and high fever (103°-104°). Two weeks ago had a prick with a bamboo chip.                          | Cellulitis   | Filters—1.0 mm. Al.<br>Current—4 ma. at 100 kv.<br>Distance—30 cm.<br>Dose—250 r.                            | 5-10-38 and 8-10-38.                     | 2   | Pain subsided after the first sitting. Fever and swelling gradually went down.  |
| 80              | K.P.   | 20  | F.  | Painful hard swelling on the lateral aspect of both the arms and high fever—duration 2 weeks.  | Abscess  | Factors the same as above.<br>Dose—100 r to each area.   | 30-10-38 and 1-11-38.                    | 2 each                                      | Complete regression in 10 days.   |
| 94              | G.     | 50  | M.  | A big painful hard swelling in the right gluteal region and high fever. Size of the swelling about 8 inches in diameter. Duration—10 days. Diabetes—1½ years | A big abscess or an early case of carbuncle with diabetes. | Filters—0.3 cu. + 1.0 Al.<br>Current—4 ma. at 150 kv.<br>Distance—30 cm.<br>Portal—8 × 10 cm.<br>Dose—150 r. | 4-11-38 and 6-11-38.                     | 2   | The pain was less after the first sitting. The inflammation subsided completely in about 2 weeks.   |
| 214             | P.D.   | 43  | M.  | A big swelling on the back near the neck with several small openings and fever 10 days. Diabetic.  | Carbuncle with diabetes.                                   | Filters—4 mm. Al.<br>Current—4 ma. at 150 kv.<br>Distance—30 cm.<br>Dose—200 r.                              | 3-3-39                                   | 1   | Healed in 2 weeks.  |
| 326             | S.K.G. | 42  | M.  | A big painful hard swelling on the chest in the right subclavicular region and high fever—one week.  | Deep abscess.  | Filters—0.5 cu. + 1.0 Al.<br>Current—4 ma. at 180 kv.<br>Distance—30 cm.<br>Portal—8 × 10 cm.<br>Dose—175 r. | 2-7-39 and 5-7-39.                       | 2   | The swelling subsided in about 2 weeks.   |
| 327             | B.C.   | 20  | M.  | A swelling about 1 inch in diameter on the nape of the neck with several small openings.   | Carbuncle  | Filters—4 mm. Al.<br>Current—4 ma. at 150 kv.<br>Distance—30 cm.<br>Dose—200 r.                              | 8-7-39                                   | 1   | The lesion healed up in a week.   |
| 330             | B.K.B. | 58  | M.  | A big painful hard swelling (about 6 inches in diameter) on the back near the neck with innumerable small openings. Fever present (sent by Capt. R. C. B.).  | Do.  | Filters—0.5 cu. + 1.0 Al.<br>Current—4 ma. at 180 kv.<br>Distance—30 cm.<br>Portal—8 × 10 cm.<br>Dose—200 r. | 3-7-39 and 6-7-39.                       | 2   | The pain subsided after the first dose, the swelling gradually shrivelled up and became softer. A week later the attending doctor made a small opening to allow drainage of the pus. The patient made an uneventful recovery. |

TABLE—*contd.*

| Register number | Name   | Age | Sex | Clinical history and findings   | Diagnosis  | Details of x-ray treatment   | Dates on which the treatments were given      | Total number of sittings given in each case | Results  |
|-----------------|--------|-----|-----|---|--|--|---|---|--|
| 333             | H.C.M. | 30  | M.  | A red angry looking swelling on the right shoulder. Size 2 inches in diameter. In the centre shows several minute openings. Fever present. No sugar in urine. | Carbuncle  | Filters—4 mm. Al.<br>Current—4 ma. at 150 kv.<br>Distance—30 cm.<br>Portal—small.<br>Dose—200 r.                     | 8-7-39 and 10-7-39.                           | 2   | The pain was relieved after the first sitting. The swelling gradually subsided and the wound healed up in about 2 weeks. |
| 339             | R.D.S. | 75  | M.  | A huge red swelling on the back with numerous openings. Duration—2 weeks. Fever present.  | Do.  | Filters—0.5 cu. + 1 mm. Al.<br>Current—4 ma. at 180 kv.<br>Distance—30 cm.<br>Portal—8 × 10 cm.<br>Dose—200 r.       | 14-7-39 and 16-7-39.                          | 2   | The swelling gradually subsided and the whole thing healed up in about 6 weeks.  |
| 374             | M.S.   | 60  | M.  | A huge red swelling on the back with many small openings—13 days, high fever. Urine—free from sugar.  | Do.  | Filters—0.5 cu. + 1 mm. Al.<br>Current—4 ma. at 180 kv.<br>Distance—30 cm.<br>Portal—8 × 10 cm.<br>Dose—175 r.       | 10-8-39<br>12-8-39<br>19-8-39 and 23-8-39.    | 4   | Healed up in 6 weeks.  |
| 398             | M.K.   | 55  | M.  | A painful swelling of the left middle finger and hand—discharging pus. Duration—6 weeks. He was operated twice and is a diabetic (sent by Dr. Ajmal Khan).    | Cellulitis and osteomyelitis (the latter condition was verified by x-ray examination). | Filter—0.3 cu. + 1 mm. Al.<br>Current—4 ma. at 150 kv.<br>Distance—30 cm.<br>Portal—8 × 10 cm.<br>Dose—125 r weekly. | 5-10-39<br>12-10-39<br>19-10-39 and 26-10-39. | 4   | Made a complete recovery without any further surgical aid.   |
| 494             | K.L.   | 16  | M.  | A painful swelling near the anus—2 months.  | Abscess (ischio-rectal).   | Filter—0.3 cu. + 1.0 Al.<br>Current—4 ma. at 150 kv.<br>Distance—30 cm.<br>Portal—8 × 10 cm.<br>Dose—125 r weekly.   | 3-1-40<br>10-1-40<br>17-1-40 and 24-1-40.     | 4   | The swelling subsided completely and has not recurred since.   |
| 580             | A.A.   | 50  | M.  | A big red swelling on the right temporal region with many small openings in the centre. Size 4" × 3"—11 days. Sugar in urine.                                 | Carbuncle  | Factors as above.<br>Dose—150 r.   | 20-4-40                                       | 1   | Made an uneventful recovery.   |
| 622             | R.S.   | 40  | M.  | A painful swelling of the palm of the left hand with fever—12 days.   | Palmar abscess.  | Factors as above.<br>Dose—150 r.   | 17-6-40 and 19-6-40.                          | 2   | Swelling and pain subsided completely.   |
| 623             | B.N.S. | 65  | M.  | A big painful swelling in the right gluteal region—1 week. High fever.  | Abscess  | Factors as above.<br>Dose—200 r.   | 18-6-40                                       | 1   | The pain was much less after the irradiation and the abscess burst 2 days after.   |



TABLE—concl'd.

| Register number | Name   | Age | Sex | Clinical history and findings  | Diagnosis | Details of x-ray treatment   | Dates on which the treatments were given | Total number of sittings given in each case | Results   |
|-----------------|--------|-----|-----|--|-----------|--|--|---|---|
| 707             | S.S.   | 45  | F.  | A very painful red swelling on the tip of the nose and high fever.                     | Boil      | Filter—1 mm. Al.<br>Current—4 ma. at 100 kv.<br>Distance—30 cm.<br>Portal—small.<br>Dose—150 r.            | 6-9-40                                   | 1   | Marked relief and complete regression.                                |
| 741             | R.B.   | 50  | M.  | Painful swelling in the right axillary region.   | Abscess   | Filters—2 mm. Al.<br>Current—4 ma. at 120 kv.<br>Portal—8 × 10 cm.<br>Dose—200 r.                          | 14-10-40                                 | 1   | Relief in pain. The abscess was subsequently opened for draining pus. |
| 812             | B.     | 39  | M.  | Painful swelling in the region of the left parotid and fever—1 week.                   | Do.       | Filters—0.3 cu. + 1 Al.<br>Current—4 ma. at 150 kv.<br>Distance—30 cm.<br>Portal—8 × 10 cm.<br>Dose—150 r. | 10-1-41 and 14-1-41.                     | 2   | Subsided completely.  |
| 832             | H.S.   | 50  | M.  | A painful swelling in the left leg with several minute openings—no sugar in the urine. | Carbuncle | Factors and dosage as above.   | 3-2-41                                   | 1   | Subsided gradually.   |
| 836             | S.N.G. | 35  | M.  | A painful swelling on the tip of the nose.   | Boil      | Filters—1 mm. Al.<br>Current—4 ma. at 100 kv.<br>Distance—30 cm.<br>Portal—small.<br>Dose—125 r.           | 5-2-41                                   | 1   | Pain and swelling subsided in 24 hours.                               |

last two and a half years, by x-rays. I admit that the number is too small to make any sweeping statement about the success of this treatment, but I was struck with the rapidity of improvement, the relief of pain, and the regression of the inflammatory process in these cases. The cosmetic result was extremely good and the healing was quicker than could be expected by any other means, including surgery.

The accompanying photographs show the result of x-ray treatment in one of my cases of carbuncle recorded here.

I am convinced that with x-ray treatment the involution occurs more quickly, the amount of necrosis is decreased, liquefaction takes place more rapidly and is less extensive, and the course of the disease is greatly decreased and at times aborted entirely, when treatment is given sufficiently early.

*Mode of action of x-rays in such inflammatory conditions.*—Various explanations have been advanced to account for the favourable influence of x-rays on inflammatory conditions and the multiplicity of such explanations probably has led many physicians to discredit the

clinical evidence or to ascribe it to over-enthusiasm of the x-ray therapist. Indeed, without a satisfactory and convincing explanation it would be difficult to believe that the same agent can be therapeutically effective against so many different forms of inflammation in different organs or parts of the body. And yet the reason appears to be quite simple and to rest on sound and abundant experimental facts. For radiation to act in much the same way, and at the same time on so many forms of acute inflammation, the lesions must have some common factor. Now, what may this factor be?

The exceptional radio-sensitiveness of certain leucocytes, notably the lymphocytes, has been demonstrated and established by the early experiments of Heineke and has since been fully confirmed by many others. All the clinical circumstances indicate that inflammatory lesions respond to irradiation in proportion to the degree of leucocytic infiltration, and that the rays act primarily by destroying the infiltrating cells. In favour of this view are the experimentally proved sensitiveness of lymphocytes on the one hand, and on the other hand the fact that the

rate of regression of acute inflammatory processes corresponds to the rate at which lymphocytes are known to be destroyed by irradiation.

The rapidity with which the symptoms often abate and the physical signs disappear after exposure to a small or a moderate dose of  $x$ -rays indicate that the destruction of lymphocytes is the primary and direct result of irradiation. The lymphocytes are the only cells in the body, except the basal epithelium of the salivary glands, which react to irradiation in such a short time and at such a rate. Also variation in the degrees of leucocytic infiltration in different patients may explain the partial or complete failure of irradiation in some cases. If it can be assumed that the leucocytes which the organism mobilizes around the site of infection represent an effort to localize the infection and to dispose of the infectious material, it must also be assumed that the infiltrating cells contain or elaborate within themselves the protective substances which enable them to destroy or neutralize the bacterial or other toxic products which give rise to the inflammation. If these assumptions are well founded it seems reasonable to deduce that irradiation, by destroying the infiltrating leucocytes, causes the protective substances contained by such cells to be liberated and to be made even more readily available for defensive purposes than they were in the intact cells.

**Conclusion.**—The evidence of the therapeutic value of  $x$ -ray treatment in acute inflammatory conditions like boils and carbuncles is so abundant and so generally favourable that one wonders why this method of treatment is not more widely used. Perhaps the very multiplicity of inflammatory lesions in which  $x$ -ray therapy has been claimed to be effective has led to not unnatural scepticism; or failure to utilize the treatment may be due to an excessive fear of ill-effects—a fear probably springing from reports of  $x$ -ray injuries incurred during treatment of malignant tumours with very large doses of  $x$ -rays, or from systemic reactions which so often follow irradiation for conditions requiring prolonged exposures. But in view of the short exposure and small doses required for acute inflammatory lesions, such as those mentioned in this paper, such fears have no basis.

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## SULFANILAMIDE IN ASCITES. UNDER WHAT CONDITIONS MAY THIS DRUG ACT AS A DIURETIC?

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PRONTOSIL and the related sulfanilamide substances have been tried in a very great variety of conditions since these drugs were introduced into clinical medicine, and they have been found very useful in many of these disease conditions. The literature on this subject has become quite voluminous. However, in that part of the literature which has come to our attention, there has been no discussion on the use of sulfanilamide in the treatment of ascites, nor have we found any mention of a diuretic action of this drug, which could be used in treatment, or of such an action appearing as a complication of its use for some other purpose.

Our interest in these problems started during our observation of the following case:—

*Case 1.*—Male, age 10. Admitted 15th October, 1937.

*Chief complaints.*—Distension of abdomen for 1½ months, much worse for 8 days. Pain in the abdomen, chiefly on the left side for 1½ months. Difficulty in breathing, and increasingly scanty urine for 1 week.

*Family history.*—Father, two sisters and one brother living and well. Mother died with swelling of whole body.

*Past history.*—Occasional colds and headache, dysentery and fever with chills were the diseases remembered, but the age at which these occurred was not known exactly by the father. There was also the history of the trouble which apparently led up to the present complaints. Five months before his admission, the boy fell from a car and developed pain in the right lower abdomen. After trying home remedies, the father brought him to this hospital. A tentative diagnosis of acute appendicitis following trauma was made, but since the hospital surgeon was on leave the boy was sent to another hospital. There he was given worm treatment and passed six roundworms. Two days later this treatment was repeated, but no more worms were passed.

Instead, the pain increased and a small swelling appeared in the right lower quadrant which persisted for 15 days. He was treated medically, the pain subsided and he went home. Two days later the pain returned and this time some indigenous remedies were used and the pain later subsided. For one month he was apparently well.

*Present illness.*—After this interval of one month the present symptoms started. This time the pain in the abdomen was more or less general, but sometimes it was localized on the left side and around to the back, and it was accompanied by slight distension of the abdomen. He was treated first at the local dispensary for 10 days and then at the headquarters hospital of the department in which his father worked. There he stayed 2 weeks, and during that time he was given medicine by mouth following which he had 2 or 3 watery motions a day—and also 6 injections in the arm. The pain decreased slightly but the distension did not diminish.

*Physical examination* on admission showed a boy of about 10, chronically ill, poorly nourished and thin, except for a markedly distended abdomen and oedematous legs and feet. Though he had no fever, his

pulse rate was 136 and his respiration rate 30. The chief findings were: moderate enlargement of sub-maxillary, jugular and posterior cervical glands, not tender, and discreet; heart rate rapid, 'tick-tack' rhythm, aortic second sound very loud, no murmurs; bases of lungs dull and few moist râles; abdomen symmetrically distended, girth—29 inches at umbilicus, measurement from xyphoid to pubis—13 inches, a number of distended veins over upper abdomen in midline and at sides, fluid thrill and shifting dullness, impossibility of palpating liver or spleen because of the tenseness of the swollen abdominal wall; oedema of legs and feet, but not of face or upper extremities.

Our impression at the time of admission was that the boy might have either cirrhosis of the liver or tuberculous peritonitis; our findings later modified this impression, but we are still somewhat in doubt as to the correct and complete diagnosis. The laboratory findings, treatment and clinical course while in the hospital are given in the accompanying table in some detail, since they have a bearing on our discussion of this case and the others that follow.

both red and white cells). This subsided, however, during the treatment with sulfanilamide. Pain in the abdomen was markedly reduced within 2 days after starting prontosil-album, and the oedema and ascites showed reduction at the same time. By 27th November the boy seemed to be cured, and therefore the sulfanilamide was stopped. However, the boy was kept in the hospital until 22nd December, with the idea of allowing him to gain weight and strength, but also that we might see how he would progress after the sulfanilamide had been withdrawn. We did not see any reason for giving it again, but it is interesting that about a week after we had stopped this drug, the boy began to ask why we were not giving him those pills. We wondered whether it might be habit-forming. We had seen no report of this

TABLE. CASE 1

| Date     | Leucocyte count | TREATMENT                  |                         |   | REMARKS   |
|----------|-----------------|----------------------------|-------------------------|---|---|
|          |                 | Sedatives                  | Diuretics               | Other treatment   |   |
| 15-10-37 | ..              | Bromides                   | ..                      | ..  | Salyrgan, because previous urine report was negative.                                       |
| 16-10-37 | 18,800          | Bromides<br>Hot water bag. | Salyrgan,<br>1 ampoule. | Cod-liver oil   |   |
| 17-10-37 | ..              | Morphine                   | "                       | ..  | Only slight reduction in swelling so salyrgan continued.                                    |
| 18-10-37 | ..              | Morphine<br>Hot water bag. | "                       | ..  |   |
| 19-10-37 | ..              | "                          | "                       | ..  | Salyrgan stopped, very little effect.   |
| 20-10-37 | 16,000          | "                          | "                       | ..  |   |
| 21-10-37 | ..              | "                          | Ammonium chloride.      | ..  | Six pints straw-coloured fluid removed.   |
| 22-10-37 | ..              | "                          | "                       | Paracentesis of abdomen   |   |
| 23-10-37 | ..              | "                          | "                       | Cod-liver oil   | Abdomen again rapidly filling, pain in same. No fever.                                      |
| 24-10-37 | ..              | "                          | "                       | "   |   |
| 25-10-37 | 18,400          | "                          | ..                      | ..  | Reduction in pain and swelling.   |
| 26-10-37 | ..              | Morphine<br>Hot water bag. | ..                      | Prontosil-album 1 tablet<br>(0.5 gm.) t.i.d. daily<br>until 8-11-37.  |   |
| 28-10-37 | ..              | Codein                     | ..                      | ..  | Temperature 102°F. for 1 day only. Ferradol given for 5 days. Marked reduction in swelling. |
| 1-11-37  | 10,400          | ..                         | ..                      | ..  |   |
| 2-11-37  | ..              | Aspirin                    | ..                      | ..  | Increased appetite. Gain in weight.   |
| 7-11-37  | ..              | ..                         | ..                      | Prontosil-album 1 tablet<br>(0.5 gm.) b.i.d. daily<br>until 26-11-37. |   |
| 9-11-37  | ..              | ..                         | ..                      | ..  | Stool examined, no ova or cysts. Kahn, just plus.   |
| 11-11-37 | ..              | ..                         | ..                      | ..  |   |
| 13-11-37 | 8,600           | ..                         | ..                      | ..  | Discharged.   |
| 20-11-37 | ..              | ..                         | ..                      | Prontosil-album stopped   |   |
| 26-11-37 | ..              | ..                         | ..                      | Cod-liver oil   |   |
| 27-11-37 | ..              | ..                         | ..                      | Cod-liver oil, calcium lactate, yeast.                                |   |
| 1-12-37  | 15,600          | ..                         | ..                      | ..  |   |
| 22-12-37 | ..              | ..                         | ..                      | ..  |   |

Several points are worthy of special attention. There was no fever associated with the leucocytosis. The white blood count was reduced during administration of sulfanilamide and elevated after it was stopped. There was no favourable effect following salyrgan, and apparently there was irritation of the kidneys by it (slight trace of albumin, granular casts and

in the literature. He also occasionally complained of pain in the abdomen, but there were no objective signs of any trouble. However by 1st December, 5 days after sulfanilamide had been stopped, the white blood count had gone up to 15,600. We did not know how to explain this. Also without apparent explanation was the single rise in temperature during

his whole stay in hospital. This was on 7th November. It rose to 102°F., and returned to normal within 24 hours.

We had witnessed what seemed to be a rather remarkable cure of ascites. But ascites is not a primary disease, and we did not have any definite idea of the aetiology of the condition in this case. We did not at the time consider any diuretic action of the drug, for though the excess fluid must have been eliminated through the kidneys, there had been nothing spectacular about it, as there is at times with salyrgan and similar diuretics. We tended rather to the view that this had been a chronic infection, perhaps a chronic peritonitis, and that the sulfanilamide in overcoming the causative agents of this had brought about a cure.

The boy returned a few weeks after discharge, complaining of recurrence of pain in his abdomen, but without any swelling. He came asking for 'those white pills'. It was impossible for his father to keep him in the hospital long, so we had to be content to follow him as an outpatient. We gave some more sulfanilamide, 3 tablets, and then 2 tablets a day for about 2 weeks. His symptoms were entirely relieved, and he has had no further recurrence of them, and has been perfectly well at the various times when we have seen him or had reports of him.

*Case 2.*—Hindu male, age 45 years. He was admitted on 25th November, 1938, and remained until 11th January, 1939.

*History.*—For one year he had had burning on micturition, and had passed blood occasionally. He took several native medicines including mercury. One month before admission after taking mercury he had swelling of the gums and fever for 10 days and then swelling, first of the face and then of the feet and abdomen, and slight diminution of the quantity of urine. The swelling of the face and feet diminished after 10 days, but the swelling of the abdomen has been steadily increasing. For the last 3 weeks there was almost no burning on urination.

*Physical findings.*—A middle aged man who is pale, emaciated, but has a markedly swollen abdomen, which is, however, not painful. Fluid thrill and shifting dullness present in abdomen, but liver and spleen not palpable. No swelling of face or feet, and heart and lungs seem to be normal.

*Laboratory findings.*—Urine: 25th November. Trace of albumin, few pus cells and few red cells. 29th November. No albumin and no red cells. Urine sediment, no gonococcus or tubercle bacilli. Stool, nothing abnormal found. Kahn, negative. Hæmoglobin 60 per cent.

*Treatment.*—Started prontosil-album 4 days after admission. [The dose in this and other cases has usually been 1 tablet of 0.5 gramme (7½ grains) every 4 hours, a daily total of 3 grammes (45 grains). This is usually continued until results are obtained, unless there is any reaction or unless the period exceeds 2 or 3 weeks, and the dose is then reduced to 2 grammes a day or less.] In this case the actual dosage was 6 tablets a day for 2 days, 4 a day for 9 days, and then 6 a day for 5 days.

During this time the swelling of the abdomen had largely disappeared, but he continued to complain occasionally of burning on urination, which became even worse when the fluid seemed to have largely disappeared from the abdomen. Thinking then that it was possible that he had tuberculosis in the kidneys, though the

treatment had been effective against a secondary infection, we cystoscoped the man on 14th December, planning to catheterize his ureters and examine the urine specimens from the kidney pelves. We were surprised and chagrined to find a stone in the bladder. This was removed by suprapubic cystotomy on 20th December. The delay after the diagnosis was made was because of the reluctance of the man to submit to operation when he had witnessed so much improvement in his original condition with medical treatment.

The sulfanilamide had been stopped on 14th December, but even after the stone was removed, the man complained of some pain in the abdomen and a little burning on urination. It was therefore given again from 27th December 6 tablets a day for 4 days, 4 a day for 9 days and then 3 a day until discharged on 11th January, 1939.

The decreasing of pain while the abdomen was filling up and the increase in pain again while the ascites was disappearing were probably related to the amount of activity of the bladder. With the diuresis, which apparently accompanied the loss of the abdominal fluid, the bladder was more active, and the stone irritated more. Here again we did not notice anything spectacular about the diuresis, but this patient, like the first one, asked for the pills when he was not feeling well, and he felt better when he was taking them.

Our impression at the time this patient was discharged was that the effect of the sulfanilamide had been to clear up a chronic urinary tract infection, after which the kidney function, which had been damaged also by the mercury, had improved and the ascites had therefore disappeared. We could not say whether the stone had developed before or after the urinary tract infection.

*Case 3.*—Mohammedan male, age 60. This man was admitted on 20th January, 1939, and discharged on 17th February, 1939.

*History.*—Fever for 2 months, at first with chills, and later without. No unusual urinary symptoms. The abdomen had been distending gradually for a month before admission, and was so tight at the time when he came to the hospital that he was having difficulty in breathing and also in eating. Much general weakness.

*Physical examination.*—Emaciated and somewhat anæmic. Heart seemed in good condition for his age and condition, lung bases were dull with diminished breath sound. The abdomen was distended, liver palpable but spleen not felt. Rectal examination showed a small hard nodule in middle lobe of the prostate which was not enlarged.

*Laboratory findings.*—Urine, albumin trace. Stool, roundworm and hookworm ova. Hæmoglobin 55 per cent. Kahn ±. White blood cell count 6,800.

*Treatment.*—Roundworm treatment was given on the second day. The hookworm treatment was postponed because it was hoped to improve his condition first. Prontosil-album was given from 24th January, 1939—6 tablets a day for 9 days, and 4 a day for 9 days. There seemed to be some improvement at first in the distension of the abdomen, but later this was just as bad as at first. The discomfort and sometimes pain in the abdomen continued. There seemed to be a little change in the irregular fever, but it did not disappear. After prontosil was stopped cinchona and iron mixture was tried, but without success. The patient was unimproved on discharge.

Was this hookworm cachexia, cirrhosis, carcinoma of prostate with metastasis in the liver, or what? We do not know. In this case, sulfanilamide did not markedly change the ascites.

*Case 4.*—B. V., Hindu, age 22. He was admitted on 15th February, 1939, and discharged on 8th May, 1939.

*History.*—A year and half before admission he had continuous fever for one month. There were no chills. After an interval of one month he again had fever for 20 days. He took native medicines. The fever left finally, but the feet began to swell. The swelling ascended up to the thighs but there was no swelling of the face and no diminishing of the quantity of urine.

There was a decrease in the œdema whenever he took a purgative, but it again returned. This went on for one year. Then began œdema of the face and swelling of the abdomen. For one month this had been very marked, and he was very uncomfortable.

*Physical examination.*—Somewhat emaciated and anæmic. Heart: loud systolic murmur over apex in 'mitral' region. Bases of lungs dull, moist râles heard. Some rhonchi over upper parts of lungs. The abdomen was much distended with fluid. Spleen and liver not enlarged. (This was corroborated even after tapping.)

*Laboratory findings.*—Urine: specific gravity 1.020, albumin trace; few leucocytes. Stool, hookworm ova found. Hæmoglobin 65 per cent. Kahn negative. White blood cell count 6,800. Blood pressure 116/90.

*Treatment.*—His abdomen was tapped and fluid removed (amount not recorded) on the first day. The next day prontosil-album was started, and was given 6 tablets a day for 5 days, then 4 a day for 9 days, then stopped for 4 days, again given 6 a day for 5 days, then discontinued for 16 days. On the 25th day (11th March, 1939), 11 pints of fluid were removed. Prontosil-album given again at 6 tablets a day for 12 days. Fifteen days after second tapping the third was done, and 10 pints removed. This was on 29th March.

At this time the patient was re-examined, and more weight placed on the heart findings. So he was digitalized, starting on 7th April, 1939, and after that a maintenance dose was given daily. We had the impression that this was doing more good than the sulfanilamide so digitalis was continued until discharge. Nevertheless, he had to be tapped, and 14 pints of fluid were removed from the abdomen on 3rd May, just 5 days before his discharge. He had been given hookworm treatment, and also iron mixture in the intervals during the prontosil therapy. He was given 2 weeks' supply of digitalis (maintenance dose of minims xv a day of the tincture) when he went home, for he lived in a village a long distance away.

*Further course.*—This patient returned from time to time. At first he seemed to be doing very well on the maintenance dose of digitalis but he was not too regular in taking it, and had to be tapped again twice during the next 5 or 6 months. He finally refused to take any more digitalis because it tasted bad, and he got some nausea from it. He then asked for some of the pills, since he thought that he had done better with them. In order to try the effect again he was given sulfanilamide to take, 4 tablets a day. When he next returned, however, he said that he had only taken 1 tablet a day. Since he was feeling better, had no œdema, and seemed to be improving or at least holding his own, we continued this up to the last time he came, about 1st December. At that time also he was given 16 tablets for 16 days.

Here again the question arises about habituation. Certainly the patient asked for the tablets, and had a feeling of well-being while taking them, but he had shown objective improvement also, though he was still not strong enough to work. But this later response to the drug occurred on a very small dose—0.5 gramme ( $7\frac{1}{2}$  grains) a day—whereas the response to larger doses while he was an in-patient had not been very marked. It is quite

probable that some change had been taking place in this young man not directly produced by the sulfanilamide, such as recovery from the effects of some of the native remedies which he had taken, though he did not know whether any of them had contained mercury. In any case, this late response to a small dose is very similar to what happened in the next patient. (A recent report has come that this young man died about one year after we last saw him. We have been unable to get further details.)

*Case 5.*—This was a Hindu male of about 40, seen only once by one of us (J. S. C.) in our branch hospital in Suriapet. We do not have a complete record of him, and he did not return for treatment but he was remarkable in that he was the first man we had seen who used sulfanilamide as a diuretic. He had been suffering for a number of months from what he described as an obstruction to the free flow of his urine, as well as from a chronic urethral discharge. He had been taking a great variety of native remedies but without result and his discomfort had been increasing so that at times he would be unable to squeeze out any urine. Then someone told him about some new pills. He tried these, and found that if he took 2 or even 1 a day he would urinate too much, but that he could keep his urine just about right by taking 1 pill every other day. When asked what the pills were he showed a bottle of sulfanilamide (B. W. & Co.).

Examination of this man showed a urethral discharge coming apparently from a chronic posterior urethritis, and also an enlarged but not especially tender prostate gland.

Though under very different circumstances from those in case 4, this man also was using sulfanilamide to increase his flow of urine. Whether in this case the drug was acting as a diuretic in the sense of increasing the secretion of urine by the kidneys we are unable to state. It cannot be assumed that he was curing the chronic infection or the enlargement of his prostate, since those were evident when we examined him, and also from the fact that if he stopped taking the pills more than 2 days, obstruction reappeared.

*Case 6.*—Christian male, age 35. This man was admitted first with acute gonorrhœal urethritis proved by positive smear. He had been suffering for about a week before coming for treatment. He was admitted on 5th April, 1939. Starting that afternoon, he was given 1 tablet sulfanilamide every 4 hours, and this was continued until the afternoon of the 7th, when it had to be stopped. He complained that he was urinating so much that although he was drinking water almost constantly he felt all dried up. The urethral discharge was less, but not entirely stopped. Local therapy was substituted, and he improved. But to ensure complete cure, and also to see whether he would again get the same extreme diuresis, sulfanilamide was again started on 16th April. The next day the man said there was someone sick at home and insisted on being discharged. We wondered if he were going, just to get away from this drug we were using, for he had started again with a severe diuresis and he told us later that this continued for a day or two after he went home.

A few weeks later this man returned with acute cardiac failure. We wondered whether this had any relation to the treatment we had given for his gonorrhœa. However, he improved rapidly with rest in bed, and antisyphilitic treatment. He had an initial infection, apparently several years before. Vitamin-B<sub>1</sub> deficiency was also probably a factor in bringing on

the cardiac failure. We did not use sulfanilamide again in this case.

*Comment.*—Four cases of ascites have been presented in 2 of which there was what appeared to be a definite therapeutic response to the use of sulfanilamide in the doses ordinarily used by us in the treatment of acute and chronic infections. In case 1, a chronic infection was suspected from the history and indicated by the leucocytosis. In case 2, a chronic infection was evident in the urinary tract. In case 3, there was no response to the treatment. In that case there was no leucocytosis, and it was not definitely determined what was the cause of the ascites. In case 4, the early response to sulfanilamide in the usual doses was not marked or unquestionable, though the late response in small doses was rather remarkable. In this case there was no leucocytosis and no proof of urinary tract infection. The other 2 cases in which there was no ascites, but in which a diuretic action of sulfanilamide seemed unquestionable, have been presented with a view to attempting to understand the action of the drug in the earlier cases.

The extreme diuresis which was noted in case 6 as a very distressing complication of the treatment of gonorrhoea has not been seen by us in any other of several hundred cases treated with sulfanilamide for a variety of diseases. However, case 5, and probably also case 4 in the follow-up period, would apparently exhibit marked diuresis if the small self-determined doses were exceeded.

There are several questions arising out of this study to which we have not yet obtained satisfactory answers. Work is now in progress with respect to some of them. However, it is hoped that other workers in the pharmacological and clinical fields who have greater facilities and more clinical material will find solutions to these problems more quickly than we can.

(1) Under what conditions may sulfanilamide act as a diuretic?

(2) Is this action the result of some type of sensitization? If so, will this explain the effectiveness of a daily dose as small as 0.25 gramme ( $3\frac{3}{4}$  grains)?

(3) Is infection of the urinary tract, either acute or chronic, one of the necessary conditions? Or may some other type of irritation of the kidneys be necessary.

(4) What is the relationship between previous mercury medication, either in the overdoses used in the indigenous treatments or in a form such as the mercurial diuretics (salyrgan, etc.) and the appearance of this diuretic effect?

(5) Is it possible that diuresis, usually mild and therefore not particularly noticed, may be one part of the effective action of sulfanilamide in gonorrhoeal urethritis?

It is commonly stated that it is unwise to give full doses of sulfanilamide in chronic nephritis,

(Concluded at foot of next column)

## LIVER EXTRACT AND SULPHONAMIDES IN SMALLPOX

By N. N. CHARI, M.B. & B.S.  
Bezwada

### Introduction

In this paper, I wish to present the treatment followed and the results obtained in a series of cases of smallpox, treated by me during the period 13th October, 1940 to 15th March, 1941, in the recent epidemic in Bezwada town. I do not claim any originality for the treatment. The chief interest of the investigation is that it combines the two remedial agents that have recently come to be recognized as of definite therapeutic value in this disease; namely, liver extract and the sulphonamide group of drugs.

The epidemic that occurred in this town may be described as a fairly severe one.

### Routine treatment of a case of unvaccinated smallpox

*Preliminary pyrexial stage.*—I have been called in to see only a few cases in this stage (before the eruption has come out). A.P.C. powder was given for the severe backache, and other pains, and a simple diaphoretic mixture for the fever. I have not been able to make out 'prodromal rashes' even in one case.

*Papular and vesicular stages.*—This is the stage during which most of the cases came under treatment, and during this stage, adults and children above three years were given liver extract injections, and little babies and patients who were against injection therapy were put on erythgen oral liver extract, one to two teaspoonfuls thrice daily, until the pustular stage was reached. The adults receive one injection per

(Continued from previous column)

especially where there is a marked reduction in kidney function, for fear of retention of this substance which is usually quantitatively excreted in the urine. Likewise, it is considered somewhat dangerous to use sulfanilamide in acute nephritis where there is already a hæmorrhagic tendency, since some cases have been reported of hæmaturia following even small doses of this drug. We had one such case in a man with acute follicular tonsillitis.

(6) Is it possible that in the presence of acute or chronic inflammation of the kidneys, sulfanilamide, in an appropriate dose as yet to be determined, may be useful for the prevention or control of water-logging?

On the basis of this brief study, we do not recommend sulfanilamide as a treatment for ascites. We have had several failures, one of which was case 3. In these patients the ascites seemed to be related to a chronic disease of the liver or spleen or both. However, we do believe that our observations should lead to further investigation of the diuretic action of sulfanilamide.



day of jectate (Upjohn) 2 c.cm. for four or five days before the pustules were formed. In one or two cases, I have used neolivacon (Union Drug Co.), 2 c.cm. ampoules, one per day.

Liver extract administration was confined to the unvaccinated cases. In only 2 or 3 of the vaccinated cases it was given because the patients were definitely anæmic.

*Pustular stage.*—Sulphonamide preparations were given to every case of unvaccinated and vaccinated smallpox, from the ninth or tenth day, till the sixteenth day of the illness. About 40 grains was the daily dosage for adults. Children were given doses proportionate to their ages. Also in severe cases, and in those which did not tolerate the medication by mouth, one or more ampoules of the injectable sulphonamide preparations were used. The sulphonamide preparations used are:—

May and Baker's sulphanilamide M.&B. 693 tablets and soluseptasine injections, 5 c.cm. of a 5 per cent or 10 per cent solution. Albert David's sulphonamide tablets, and sulphonamide soluble injections. Union Drug Co.'s urea sulphazide tablets and urea sulphazide injections.

The above is a brief outline of the liver extract and sulphonamide medication; I have also adopted a routine for the care of the eyes, etc., which is as follows:—

*Eyes.*—The eyes were daily washed with boric lotion, or magnesium sulphate solution (saturated), argyrol (20 per cent) drops were instilled, and unguentum hydrargyri oxidi flavum was smeared along the edges of the eyelids. Unguentum hydrargyri nitratis,  $\frac{1}{2}$  B.P. strength is also satisfactory for smearing the eyelids.

*Ears.*—In cases where the eruption affected the skin of the external auditory meatus, glycerine carbolic ear drops were used.

*Nose.*—In mild cases, liquid paraffin, 2 or 3 drops, was put into each nostril; in noses, badly affected, endrine drops were put, or the same was sprayed into the nostrils.

*Mucous membrane of the mouth, tongue, etc.*—Glycerine boric was given to the patient, to paint the mouth cavity, and the surface of the lips and tongue, twice or thrice daily. During the latter half of the pustular stage, potassium chlorate gargles (10 grains per ounce) were prescribed.

*Larynx.*—The larynx was affected in a majority of the unvaccinated cases as also in a few of the vaccinated cases. Steam inhalation (twice or thrice daily) with lysol or compound tincture of benzoin (20 drops of either in a pint of boiling water) was advised for these cases.

*Skin.*—During the papular and the vesicular stages of the disease, the skin of the body, except the skin of the scalp, was wetted with cotton-wool dipped in saturated potassium permanganate lotion, and immediately wiped dry with a soft towel. During the pustular

stage, carbolic lotion, 1 in 20, was used in a similar way.

Most of my cases were from the *cheries* (poor-class dwellings) and in order to prevent the ants from victimizing the patient, his relatives were told to put the feet of the cot on small tins filled with water, so that the ants could not creep up the cot.

*Genitals.*—In the case of the female, the eruption on the skin of the labia and the mucous membrane of the vagina is a source of great discomfort. Washing the parts with warm boric lotion, thrice daily and painting the external skin with calamine ointment (Upjohn) gave a fair amount of relief in these cases.

*Bowels.*—Warm water enemata were used in the apyrexial stages of the illness, and glycerine enemata were the routine in the pyrexial stage.

*Sleep.*—This was ensured by giving a chloral and bromide draught during the papular and vesicular stages of the disease. In the pustular stage of cases treated by the routine in the earlier stages, there was practically no need to give medicines for sleep.

*Diet.*—During the pyrexial stage we have restricted the patient's diet to fluids only—barley water, glucose water, cow's milk, weak coffee or tea, ovaltine, milo, malted milk, arrow-root congee, etc. During the apyrexial period, the patient was allowed to take a light rice diet, with vegetable curry, pepper water and fresh buttermilk. After the sixteenth day of the illness, or earlier if there was no pyrexia, the patient was allowed gradually to increase his diet.

#### *Routine treatment of a vaccinated smallpox case*

The treatment of a case of smallpox in a vaccinated person differed from that of an unvaccinated person, in that no liver extract was given in any form to the former. Sulphonamide in the dosage indicated was the main factor in the treatment, and was given between the ninth and the sixteenth days. The routine treatment of the eyes, nose, etc., was however followed throughout the illness. It is my considered opinion that liver extract need not be given to cases of smallpox in the successfully vaccinated, provided not more than 25 years have elapsed since the successful vaccination.

#### *Complications, their prevention and treatment*

*Hyperpyrexia.*—This was conspicuous by its absence in my series of cases. This is probably due to the liver extract and sulphonamide medication. It is also to be stated here that cryogenine (Lumiere) in 1 to 5 grains dosage (according to age) was given to the patient's attendant, to be given by mouth to the patient if the temperature went up to more than 103°F.

*Myocardial failure.*—In cases of suspected myocardial weakness, glucose and brandy (1 to 2 fluid drams per 1 ounce of glucose water) were given every 4 or 6 hours. In cases evidenced by definite weakening of the first sound of the heart



and a weak pulse, coramine, camphor in ether, etc., have been used.

*Respiratory distress.*—This is caused by the physical obstruction to the air passages, whose mucous membrane is covered by the eruption. Also the vocal cords in the larynx are subject to inflammatory changes similar to the peripheral eruption, and are able to obstruct more effectively. There is an increased formation of mucus, adding to the trouble, and producing a rattling noise in the throat during respiration. By giving steam inhalation, with lysol or tincture of benzoin, loosening of the mucus and its expulsion were considerably helped. In cases where the obstruction was considerable, and likely to tell on the muscles of respiration, I have used injections of strychnine sulph. 1/100 to 1/60 of a grain, to stimulate the muscles to perform their task more efficiently.

*Anuria and nephritis.*—Many of the severe confluent cases suffered from anuria for 24 hours or more, owing probably to the intense toxæmia. Potassium citrate, 20 to 30 grains per dose (or according to age in children), given once every 2 or 3 hours for two or three doses, produced urination in almost every case. True nephritis with swelling of the face and albumin in the urine was met with only in one case, and the sulphonamide which this patient was getting at this time was stopped and she was put on barley water and on alkaline diuretic mixture. The next day the swelling subsided and the albumin in the urine was much less. This is more likely to have been a case of nephritis due to the sulphonamide, than due to the acute infectious disease.

*Joint troubles.*—Many of the cases in which the joint complications occurred were those that had not received any sulphonamide at all, or those that did not get a sufficient dose of it, for one reason or another. The commonest manifestation was synovitis with effusion; the joint most affected was the elbow. It was in every case relieved by thermoplast (Andhra Pharmaceutical) dressings, and sulphonamide administration. Glycerine ichthyol dressings also helped in a few cases, but these were applied only after the sulphonamide was stopped.

*Asthma and smallpox.*—There were two cases of asthmatics, attacked by smallpox. Both were unvaccinated; and the disease was in each case of the most virulent type. These also suffered from greater respiratory distress than a severe unvaccinated case, similarly affected. Both of them died, and I have, after the experience, come to doubt the wisdom of liver extract administration in the asthmatic cases.

*Menses and menstrual troubles.*—I have seen a few cases in which patients happened to get their monthly periods during the acute stage of smallpox. The bleeding was more than usual in cases in which it used to be normal in amount during health. In cases, with a history of menorrhagia, it was more profuse than ever, and

one of my cases was lost due to the excessive bleeding alone.

*Pregnancy and smallpox.*—One of the unvaccinated cases was in the seventh month of pregnancy at the time of the onset of the attack, and was having a temperature of 105°F., on the occasion of my first visit, which was a few hours after the eruption was noticed. She had two abortions before this pregnancy. She was given the routine treatment with jectate injections and M.&B. 693 tablets, and she recovered nicely. This was a confluent type of case; still there was really no occasion on which fear was felt for the sake of the foetus. The mother had swelling around the ankles on the fourteenth day of illness; she was put on glucose and brandy every six hours and she rallied very well. I saw the baby on the third day of its birth, and there was no evidence of the disease on her. But, though born full-term, she was a puny little thing and had big fontanelles, at least twice the size of those of a normal child at birth. Her eyes were apparently unaffected.

#### RESULTS

|   |       |
|---|-------|
| Total number of cases treated during the acute stage of the disease (vaccinated and unvaccinated) .. .. | 68    |
| Total number of deaths .. ..  | 11    |
| Percentage mortality .. ..  | 16.17 |
| Total number of unvaccinated cases .. ..  | 41    |
| Number of deaths in above .. ..   | 10    |
| Percentage mortality .. ..  | 24.4  |
| Total number of vaccinated cases .. ..  | 27    |
| Total number of deaths in above .. ..   | 1     |
| Percentage mortality .. ..  | 3.7   |

This case of death from the vaccinated series did not show any vaccination marks; probably the vaccination was unsuccessful. He had a septic wound on his left foot which had been bleeding, unattended to for the previous ten days, and he died within ten hours of commencing treatment.

Except for this case, there was no fatality in the vaccinated cases.

|   |      |
|---|------|
| Total number of unvaccinated cases treated with liver extract injections and sulphonamides .. ..    | 21   |
| Number of deaths in above .. ..   | 5    |
| Percentage mortality .. ..  | 23.8 |
| Total number of cases (babies and children) treated with oral liver extract and sulphonamides .. .. | 8    |
| Number of deaths from above .. ..   | 3    |
| Percentage mortality .. ..  | 37.5 |

#### Rôle of liver extract in smallpox

1. Liver extract does not abort the disease or do away with the pustular stage of the disease altogether.
2. The toxicity of the acute stage of the disease is definitely lessened by liver extract which minimizes the mortality as well.
3. In the fulminating types, where the eruption fails to develop into the vesicular stage, after two or three liver extract injections, the eruption comes out nicely, with diminution of the general toxic symptoms, like delirium. That is, it tends to make the disease take a more normal course.

4. Hæmorrhages into the vesicles have not been seen in this series of cases. This is probably due to liver extract. In a few cases of persistent small hæmorrhages from mucous membranes, liver extract injections have proved useful in stopping these.
5. Because the patient's resistance is increased by the liver extract administration, he suffers less damage to his vitality, and hence the convalescent period is lessened.
6. In all the cases treated with sulphonamides, and especially those that received liver extract as well, disfigurement due to pitting is certainly less than an untreated case of smallpox of equal severity. But I am inclined to give the credit for this to the sulphonamides, which by lessening the amount of the inflammation in and around the vesicles reduce the ultimate damage to the skin and minimize the disfigurement.
7. I do not think that liver extract is a necessary (for the saving of life) medication in cases of smallpox in the successfully vaccinated. Of course the patient stands to gain by getting it. But in an epidemic, it is probably cheaper to confine liver extract administration to the unvaccinated cases only. I have had no occasion to regret my not having given liver extract to the successfully vaccinated cases.
8. Liver extract orally administered, is far less efficacious in this disease than injectable liver extracts, probably because the latter act more quickly.

#### *Rôle of sulphonamides in smallpox*

1. Sulphonamide does not abort the disease, or do away with the pustular stage even if given earlier.
2. Sulphonamide is certainly a necessary and valuable drug in the pustular stage of the disease, both for lessening the evil effects of sepsis in the acute stage and for preventing the incidence of late septic manifestations such as boils, abscesses and joint troubles.
3. Sulphonamide definitely tends to lessen the mortality of the disease.
4. By reducing the inflammation, it lessens the damage to the skin, and consequently minimizes the disfigurement.
5. In cases where the mucous membrane of the upper respiratory passages is affected, M.&B. 693 seems to be the drug of choice, for administration during the pustular stage, in the place of ordinary sulphanilamide, probably because of its specific effect against the pneumococcus,

which is a normal inhabitant of the mouth, etc. In some persons whether this explanation is correct or not, there is no denying the fact that M.&B. 693 is a more efficacious drug to use than the ordinary sulphanilamide in the pustular stage of smallpox.

All the liver extract injections, Upjohn's jectate, and Union Drug Co.'s neolivacon, were freely given to the Smallpox Free Dispensary (of which I was the honorary medical officer) by Messrs. T. M. Thakore and Co. of Bombay and Messrs. Union Drug Co. of Calcutta, respectively. Erythgen oral liver extract was given to us by Messrs. Muller and Phipps, Bombay.

Almost all the sulphonamide used was freely given to the dispensary by:

Messrs. Albert David Ltd. of Calcutta.

Messrs. Union Drug Co. of Calcutta.

Messrs. May and Baker (India), Ltd., Calcutta.

I wish to thank them all heartily for their generous help.

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## A Mirror of Hospital Practice

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### INTRAPARTUM UTERINE RUPTURE

By GERALD H. COORAY, M.B., B.S. (Lond.),  
M.R.C.S., D.T.M. & H. (Eng.).

*Surgical Registrar, General Hospital, Colombo, Ceylon*

THE interesting article of Professor H. S. Waters, on the above subject, which appeared in the *Indian Medical Gazette* of September 1941, prompts me to record the following case of rupture of the uterus during labour:—

*Clinical history* (obtained from deceased's brother).—Primipara, aged 30 years, was living in a small hut in a remote village with her younger brother, a lad of about 14 years. There were no other inmates in the house. At night she got labour pains and went inside the only room of her hut and bolted the door. Her brother, who was in the verandah, heard her groaning for some time, but not paying any attention to this, he fell asleep. He awoke in the morning and called his sister. Getting no answer he forced the door open and found her dead.

A post-mortem examination was performed by me on the same day, about 12 hours after death.

The body was that of a well-nourished woman. The peritoneal cavity contained about 2 pints of blood. The uterus was enlarged to the size of a full-term pregnancy. On its left side, lying free in the abdomen, was a full-term male foetus with an enormous head due to hydrocephalus. On the left lateral wall of the uterus, commencing at the junction of the upper and lower uterine segment, there was a complete rupture of the muscle about 6 inches long, through which the foetus had escaped into the abdominal cavity. The placenta had separated and was lying free in the uterine cavity, which contained blood.

There was no pelvic contraction, but the foetal head was considerably enlarged resulting in marked disproportion. The enlargement of the head was due to an extreme degree of hydrocephalus and on evacuation of the fluid two rounded masses about the size of a lime were seen. These represented the cerebral hemispheres.

#### *Comment*

The cause of the rupture in this case was not the same as in Professor Waters' four cases. In

two, the rupture is stated to have been probably caused by manipulation and in one it was due to degenerative changes in the uterine wall. In the fourth no obvious cause was found. In this case there is no doubt that the rupture was brought about by obstructed labour due to a marked disproportion between the child's head and the pelvic inlet. This would have been detected, if the unfortunate woman had attended an ante-natal clinic. If medical aid was available during labour the catastrophe of rupture would have been avoided by perforation of the head. Unfortunately, labour took place many miles from medical aid, not an uncommon occurrence in India.

## INTUSSUSCEPTION CAUSED BY AMÆBIC DYSENTERY

By A. K. MAKFUZAL HOQUE

Resident Medical Officer, Surgical Ward, Mitford Hospital, Dacca

THE following case is worthy of record as it must be rare to find a chronic intussusception due to dysenteric thickening and ulceration of the cæcum:—

*Case history.*—S., aged 12 years, a Muslim male, was admitted into the Mitford Hospital, Dacca, on 16th August, 1941, complaining of abdominal pain and diarrhoea with blood and mucus.

*Examination.*—A thin, lightly-built boy. He had a movable tumour in the epigastrium. The abdomen was soft and there was no tenderness. His relatives stated that he had had an acute attack of dysentery one month previously and the lump appeared in the abdomen at that time. There was no history of vomiting or other signs of obstruction. The lump persisted and the dysentery, though somewhat improved, still continued.

Stools showed *Entamoeba histolytica*, both vegetative and cysts, in very large numbers. A diagnosis of chronic intussusception due to amœbic thickening was made and the patient was started on a course of emetine and low-pressure carbarsone bowel washes. Instructions were given to keep the patient under strict observation and to report any rise in pulse rate or any signs of obstruction. After seven days the patient's general condition was better and the stools were free from *E. histolytica* but still contained some mucus. Intussusception was confirmed by a barium enema and operation was decided upon.

*Operation note.*—Under general anaesthesia the abdomen was opened by a right paramedian incision, about three inches long, with its centre opposite the umbilicus. The apex of the intussusception was found at the splenic flexure and the reduction was easy because no adhesions had formed between the layers of the intussusception. When reduction was complete the cæcum was easily drawn from the wound and was found to have a very long mesentery, at least seven inches in depth. When the cæcum was inspected it was found that even the small amount of pressure required to reduce the intussusception had caused a perforation of an ulcer at the base of the appendix. The appendix was removed and the stump, along with the perforation, was invaginated by a few Lembert's sutures. The thickened and friable condition of the cæcal wall prevented the use of the usual purse-string suture. The abdomen was closed in layers and a drain left in the cæcal region, through a separate stab wound.

*Post-operative progress.*—As the patient had some chronic bronchitis and as there had been some contamination from the cæcal perforation he was given M.&B. 693, two tablets hourly, but in spite of this pneumonia developed on the second day. M.&B. 693 was continued for three days and the patient gradually

improved. The drainage tube was removed on the third morning and the stitches on the seventh morning. A course of carbarsone was given by mouth and he left the hospital quite well on the twentieth day after operation.

My thanks are due to Major Fisher, I.M.S., Superintendent of the Mitford Hospital, Dacca, under whom the patient was admitted and who performed the operation, for permission to report this case.

### X-ray note by R. M. Roy Chowdhury Opaque enema examination

The opaque fluid reaching the recto-pelvic junction ceased to flow onward for a considerable time. Afterwards it was noted to climb up the sigmoid and the left colon and, reaching the splenic flexure, it was again seen to be arrested. Pain and discomfort were complained of.

On palpation the whole of the transverse colon was definitely tender and firmly rigid and it was seen like a balloon. Saccules of the ascending and right half of the transverse colon were seen to be most unusually close to one another, so much so that the plica semilunaris coli appeared as thickly set concentric rings resembling a cushion spring.

Modified Trendelenburg's position was made and on elevating the buttocks, the fluid was seen to flow onward and in a very thin layer through the ballooned gut, surrounding an axis made of a thin stream of barium for a small distance in the right half of the transverse colon; it appeared to be composed of two tubes, the inner being very narrow and tubular and the outer one a hollow cylinder covered with a thin layer of the opaque fluid. The gut proximal to it was enormously dilated.

After another half hour no further onward flow could be noted except that a very thin layer of the fluid was seen to pass most reluctantly through the jacket tube and this made the rings, noted before, more prominent. The right iliac fossa and the right lumbar region appeared to be empty and no resistance could be felt.

Skigrams taken in two different planes corroborate the finding stated above.

*Conclusion.*—The evidence is that of intussusception. The thin stream of barium is in the intussusception and the cylinder of barium lies between the intussusception and the intussuscepiens.

## A CASE OF POST ECLAMPSIA

By SURENDRA MOHAN ROY, L.M.P.

The Barada Pharmacy, Pukurpar, Pabna

*History.*—A girl aged 15—primigravida—full term pregnancy, œdema all over the body especially the feet, delivered of a healthy child on 2nd October, 1941, at 10 p.m. Four hours after delivery the patient complained of intense headache and soon eclamptic fits started. I attended the patient and observed the following conditions—temperature 103°F., pulse 130, comatose, eyes and face congested, fits every 15 to 20 minutes, laboured and stertorous breathing, twitching of the muscles of the face and extremities, tossing of the hands and fixation of the eye.

*Treatment.*—Stronganoff's treatment was immediately started and 25 c.cm. of 25 per cent glucose was injected intravenously, 15 c.cm. of 25 per cent magnesium sulphate was given intramuscularly and 2 c.cm. iodine solution was given intravenously. A mixture containing 30 grains of chloral hydrate, 2 drachms of infusum digitalis and 4 ounces of normal saline was given slowly per rectum. After this treatment she had 3 fits in 3 hours. About 4 ounces of blood was let out by venesection. After venesection the picture of the patient completely changed. She became quieter, breathed easily, the rhonchi of the lung disappeared—blood pressure fell, improved diuresis, diminished œdema. The patient became fully conscious after 12 hours.

## GANGRENOUS STOMATITIS TREATED WITH M&B 693

By D. N. DEB SARMA

Medical Officer, Duliabam Tea Estate, Khowang, Assam

On the 3rd September, 1941, a poorly-nourished coolie woman aged about 35 years came to hospital for treatment for swelling and pain in her right cheek, and fever. She had been suffering from a bad tooth of the affected side for four days previously, felt pain and swelling in her cheek on the previous night, and fever came only in the morning.

I found the following:—

1. Decay of the lower second molar tooth.
2. A scratch on the mucous membrane opposite the carious tooth.
3. A painful swelling of both the gum and the cheek with much induration of the latter.
4. Other signs and symptoms of inflammation, *e.g.*, redness and tenderness on the external surface of the cheek, fever (102°F.).

The salivary glands also were inflamed.

Examination of other systems revealed no abnormality. No history of malaria or any other previous illness was obtained. The clinical signs and symptoms suggested the condition to be a case of simple inflammation. Consequently a solution of potassium permanganate (1 in 1,000) for gargle, a magnesium sulphate-glycerine paste for application on the cheek and a mixture of quinine, iron and nux vomica and magnesium sulphate for oral administration, three times daily, were given. No improvement was seen the next morning except a fall of temperature from 102° to 100°F. A marked aggravation of all other symptoms was noticed instead of any improvement. An offensive sloughing punched-out ulcer inside the cheek and a glazed, dusky red, indurated spot on the external surface of the cheek were observed. The case was finally diagnosed as cancrum oris and the patient was immediately given three tablets (0.5 gm. × 3) of M&B. 693, dissolved in water, and then she was given two tablets four hourly for 24 hours. Thus she took only 15 tablets, and this controlled the infection. The patient was then given stimulants, milk diet and iron and quinine mixture for a few days. Washing and dressing were continued throughout the period. There was, however, a small perforation in the cheek and I had to remove the slough and evacuate the retained discharges by incision inside the cheek. The ulcers healed up completely within a fortnight.

Another case of noma (coolie, male, 28 years) was treated with Seroid, a preparation of sulphanilamide, manufactured by the Standard Pharmaceutical Works. High temperature, marked toxæmia and sloughing of the ulcer were the chief symptoms when I saw the case first. An injection of Seroid 5 c.cm. was at once given intramuscularly. Then he was given Seroid tablets for two days, 2 tablets for a dose and at an interval of 6 hours. This controlled the infection but the patient died of pneumonia in the fourth week after his admission.

Points of interest :

1. A very small quantity of 'sulphonamide' was required in both the cases.
2. Absence of constitutional symptoms in the first case.
3. In the first case fall of temperature in spite of a marked progress of the infection.
4. In the second case it is interesting to note that the patient was attacked by pneumonia after his oral sepsis was cured.

## TOXIC EFFECT OF SULPHAPYRIDINE ON THE LIVER : A CASE REPORT

By MAN SINGH

MAJOR, I.M.S.

D. A. D. P., Lucknow District, Ranikhet, and Officer in-charge, District Laboratory, Ranikhet

*History.*—An infant aged 4 months was brought to hospital in a moribund state and died within half an hour. On questioning, the mother said that the infant became ill on the previous day with a mild temperature and she took the child to a private practitioner who prescribed a cough mixture and  $\frac{1}{4}$  tablet of sulphapyridine every 3 hours. The child did not respond to this treatment and became worse. The mother became alarmed and brought her to hospital. The mother was extremely vague about the dosage and the time it was started. Four grammes or possibly more of the drug were given in 36 hours.

The child was pulseless on admission with cold blue hands, blue lips and ears; no rash, and a temperature of 102°F. was noted before death. On account of lack of knowledge of the child's recent history, autopsy was considered necessary.

*Pathological report.*—Lung, cerebrum, cerebellum, spleen, pancreas and kidney—normal in appearance.

*Liver.*—Hepatic cells show cloudy swelling and a certain amount of degenerative changes amounting to necrosis.

*Comment.*—As practically all the organs, especially in a child of that age, were found normal the cause of degeneration and necrosis of the liver cells was first thought to be specific. Further sections were cut and stained with selective stain (Levaditi's) and syphilis was excluded.

The toxic effects of sulphanilamide on the liver are known. Davis, Harris and Schmeisser (1940) experimenting with rats have shown irregularly-placed focal areas of necrosis of the liver cells on various occasions when large doses were injected, but as far as I am aware only 2 fatal cases from sulphanilamide poisoning have been reported in English so far. One was by Cline (1938) of acute yellow atrophy and the other toxic hepatitis (subacute yellow atrophy) reported by Berger and Applebaum (1941).

With increasing use of this drug more cases of hepatitis are to be expected. Whether this injury is due to toxicity or hypersensitivity, it is difficult to say though I am inclined to think the latter because if it were toxicity one would come across many more cases in hospitals.

I wish to thank the Officer Commanding B.M.H., Allahabad, for his permission to report this case.

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# Indian Medical Gazette

FEBRUARY

## INFANTILE BERI-BERI

IN all Eastern countries in which beri-beri is prevalent, the disease is known to be common in infants. According to figures reported by Burnet and Aykroyd (1935)\*, about one-third of the deaths from beri-beri in Japan during the years 1928-32 were in infants under one year, while in Manila in the Philippines during the same period the infantile deaths constituted about half the total deaths from beri-beri. In India, adult beri-beri is a common disease in the Northern Circars district of the Madras Presidency, but beri-beri in infants has not hitherto been observed and described. Experience in other countries suggests that it is likely to be a common condition in the beri-beri area.

Two recent papers throw light on this question. Rao (1941)† reports five cases of a condition locally known as 'anasa' which were admitted to the King George Hospital in Vizagapatam. All these were breast-fed infants; three were aged 3 months, one 4 months, and one 2½ years. Signs included screaming, restlessness, cyanosis, dyspnoea, feeble and husky voice, and vomiting. In most cases the mother showed evidence of beri-beri or peripheral neuritis. Treatment of the infant by pure vitamin B<sub>1</sub> (1 to 5 mg. daily) had an immediate effect, leading in most cases to disappearance of signs within 24 to 48 months. It is not stated whether the vitamin was administered orally or parenterally.

Aykroyd and Krishnan (1941)‡, having observed cases of infantile beri-beri clinically, approached the problem by the study of provincial and municipal records of infantile mortality at various periods of infancy. It is known that beri-beri is most common in breast-fed infants at about the third and fourth months of life. The annual reports of the Director of Public Health, Madras, provide data about infantile mortality in municipalities in the Madras Presidency, deaths being grouped under the periods 0 to 1 month, 1 to 6 months and 6 months to 1 year. A comparison was drawn between the proportionate mortality in these periods in 17 towns in the Northern Circars and 17 towns south of Madras City outside the beri-beri area in 1938, the total population concerned being approximately the same in each case. It was

found that in the beri-beri area a greater proportion of infant mortality occurred in the period 1 to 6 months than in the periods 0 to 1 month and 6 to 12 months. In the other towns and in British India generally, the greatest proportionate mortality occurred during the first month of life.

A detailed study of the available records of infant mortality in the age group 0 to 6 months, at each month of life, was made in 6 municipalities, 3 in the beri-beri area and 3 elsewhere in the province. The period covered was the years 1935-39. In the towns in the beri-beri area there was a sharp and constant peak in mortality at the fourth month of life, not visible in the records of other towns. The authors remark that while the inaccuracy of vital statistics in India is generally recognized, they 'can think of no reason why more deaths should be consistently recorded as occurring in the fourth than in other months, except the obvious one that more deaths actually occurred in the fourth month'.

They point out that their observations, though suggestive, do not *prove* that beri-beri is an important cause of infantile mortality in the Northern Circars. Proof can be obtained only by field observations and investigations in which the cause of infant deaths is carefully investigated and trial is made of the effect of vitamin B<sub>1</sub> on sick infants. Medical practitioners and health officers in the beri-beri area should be on the look-out for infantile beri-beri in its various manifestations. While acute fulminating beri-beri may be rare in infants outside the beri-beri area, it is possible that minor degrees of vitamin-B<sub>1</sub> deficiency may be an important cause of 'failure to thrive' and ill-health among infants.

Aykroyd and Krishnan give the following clinical description which they say is based on textbook accounts and their own observations:—

'Beri-beri usually occurs in breast-fed infants aged 3 to 4 months. Often the child fails to gain in weight during a week or so previous to the attack. In the acute form the infant is suddenly seized with what appear to be severe paroxysms of pain; during a paroxysm it may straighten out its body and become quite rigid. Between attacks, the muscles feel abnormally soft and flabby. Vomiting is frequent. There is usually cyanosis and coldness of the extremities and difficulty in breathing is obvious. Right-sided dilatation of the heart is common and the pulse is weak and rapid. Excretion of urine is diminished. General oedema is rare but localized oedema may be observed. A husky or almost inaudible voice, due to oedema of the larynx and not to paralysis of the vocal cords, is very characteristic of infantile beri-beri. The knee-jerks may be absent. Death often occurs within 24 hours unless the appropriate treatment is given.'

In more chronic cases the usual clinical picture is that of a pale, flabby baby, not gaining in weight and becoming weaker and weaker. Vomiting and constipation are frequent. Infants with chronic beri-beri may die suddenly of heart failure.

Examination of the mother will often reveal evidence of beri-beri in the form of slight paresis, difficulty in walking, and numbness and tingling in the extremities. She will often describe the sudden death of previous infants at the age of 3 to 4 months or thereabouts.

The therapeutic test is the most satisfactory method of diagnosis. Injection of pure synthetic vitamin B<sub>1</sub>

\* BURNET, ET., and AYKROYD, W. R. (1935). *Quart. Bull. Health Organization, League of Nations*, 4, 323.

† RAO, C. K. P. (1941). *Indian J. Pediat.*, 8, 241.

‡ AYKROYD, W. R., and KRISHNAN, B. G. (1941). *Indian J. Med. Res.*, 29, 703.

may relieve an infant which appears to be almost moribund. In very acute cases less concentrated preparations, such as yeast or extract of rice polishings, may not have time to act, but they may be effective when the condition is less grave—witness the success achieved in the Philippines in the treatment of infantile beri-beri with “tiki-tiki”, an alcoholic extract of rice polishings.

Finally the following passage from a letter written by a hospital physician in a town in the Northern Circars in December 1941 is interesting and instructive:—

‘Although many patients present symptoms suggestive of vitamin-B<sub>1</sub> deficiency, we have seen very few cases of severe beri-beri this year. If this applied only to patients who come regularly to the hospital for treatment or ante-natal care, we might ascribe it to success in our efforts to educate the people; but it applies also to outlying villages, for very few beri-beri patients have been brought from them. It would seem that the high price of milled rice has made many people eat other grain at least for one meal. Neither have we had any cases of acute, i.e., fulminant, beri-beri in infants this year, though mothers still report cases where an apparently healthy baby has begun to scream and died before the child could be taken to hospital. We have, however, had many cases of ill-nourished babies whose condition appeared hopeless, and yet rapid recovery followed after vitamin B<sub>1</sub> was given by injection. We are now giving bigger dosage, 25 mg. to adults with marked dyspnoea, and 5 to 10 mg. doses to infants.’

A.

### PLAGIARISM

We regret that we must admit to having been unconscious accomplices in an act of flagrant plagiarism.

In a recent number we published a paper on a certain modern surgical procedure. We accepted and published this article in good faith believing that it was an original description of this particular technique. We did not imagine that all the ideas were original; in fact we naturally expected that the authors would have

taken full advantage of all the recent literature on the subject and have added practical points from their own experience under local conditions, but we certainly did not suspect that more than three-quarters of the article was a word for word, sentence for sentence, and paragraph for paragraph a copy of a paper that had appeared in an English contemporary only a little over a year earlier.

We remonstrated with the perpetrators of this blatant plagiarism. The excuse given by the junior writer was that the substance of the paper had been given to him as a guide to procedure, by his late chief in a medical college hospital where he had been a house surgeon, and that he did not know that it was copied from a published paper. If this statement is true, it only seems to us to deepen the hue of the crime, for the writers gave no indication in the paper that they were reproducing word for word another surgeon's instructions and there was no acknowledgment of any kind. The senior ‘writer’ appears to have had nothing to do with writing the paper, beyond ‘correcting’ the typescript and disclaims all knowledge of the source. This habit of claiming joint authorship without any justification is unfortunately not an uncommon one in this country. One great danger of such a procedure is here exemplified.

We are not proud of our share in this unfortunate incident, particularly as the medical journal in which the paper appeared is on our exchange list, but it is humanly impossible for us to be familiar with all the tens of thousands of medical articles that are published annually. We owe our sincere apologies to the journal and author in question, and these apologies have been issued, though we have not yet received any complaint from these sources.

## Special Articles

### THE ANTI-PELLAGRA FACTOR\*

By K. V. GIRI, D.S.C., A.I.I.S.C., F.A.S.C.

(From the Biochemical Laboratory, Andhra University, Waltair)

THE pellagra-preventive factor belongs to the important group of B-vitamins. The discovery of this vitamin and its therapeutic value in pellagra are of very recent date. Dr. Joseph Goldberger, a surgeon in the United States Public Health Service was the pioneer in the discovery of the cause and cure of pellagra. In 1926, it was first shown by Goldberger and co-workers (1926) that the water-soluble B was a complex

composed of at least two dietary essentials—one, which is necessary for growth and prevention of polyneuritis and unstable to heat, and the other also necessary for growth and for the prevention of a pellagra-like dermatitis in rats, which is relatively stable to heat. These two factors came to be known as anti-neuritic vitamin and the anti-pellagra factor and also as vitamins B<sub>1</sub> and B<sub>2</sub>, respectively. Goldberger considered that the anti-pellagra factor was identical with a vitamin which prevented pellagra in human beings. This factor was later on called vitamin G. The same factor was thought to be identical with a factor which prevented black tongue in dogs and rabbits (Goldberger *et al.*, 1928).

Thus ‘vitamin B<sub>2</sub>’ was found to possess the following properties:—

\* Andhra University Extension Lecture, delivered at the Andhra Medical College, Vizagapatam, on 17th January, 1941.



1. It was essential for rats as a supplement to vitamin B<sub>1</sub> for normal growth.

2. It protected against rat pellagra, originally described by Goldberger and Lillie (1926) and also called 'rat acrodynia' by György *et al.* (1937). It is characterized by florid dermatitis, roughly symmetrical with swelling and redness of the digits of the paws and ears.

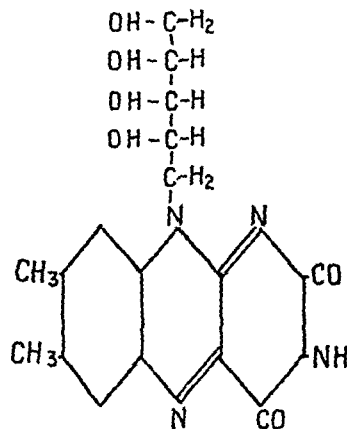
3. It protected against black tongue in dogs.

4. It cured pellagra in human beings.

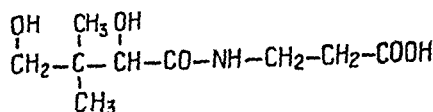
Later investigations showed that the pellagra-like dermatitis in rats was difficult to produce, and the vitamin G content of foods was therefore, determined biologically by its stimulating effect on growth. It was, however, soon revealed (Aykroyd, 1930) that vitamin G or B<sub>2</sub> as it was named by English authors was present in food-stuffs which are constituents of typical pellagra-producing diets. It, therefore, became clear that the vitamin is composite. The first step towards the characterization of the complex was the recognition that lactoflavin had growth-promoting activity for rats (György *et al.*, 1933). Later it was proved that the growth-promoting effect of the vitamin B<sub>2</sub> complex was due to lactoflavin, and it was shown to be different from the 'rat pellagra' factor, which was subsequently named 'vitamin B<sub>6</sub>' (György, 1935; Harris, 1935; Chick *et al.*, 1935) which has since been separated in the pure crystalline state (Lepkovsky, 1938; György, 1938; Kuhn and Wendt, 1938; Keresztesy and Stevens, 1938).

Lastly, it has been shown (Birch *et al.*, 1935) that the factor which protects against human pellagra (P-P factor) is another component of the vitamin B<sub>2</sub> complex. Thus it was only in the year 1935, that it was recognized that 'vitamin B<sub>2</sub>' is a complex containing several vitamins. Since then the family of B-vitamins has grown enormously, and we have at present not less than ten vitamins in the family. The exact number of vitamins present in the vitamin B complex, which are essential for human beings, is still undetermined. There are, however, four vitamins about which sufficient evidence exists to warrant discussion in connexion with the treatment and prevention of pellagra. These are riboflavin or vitamin B<sub>2</sub> (G); the rat anti-dermatitis factor or vitamin B<sub>6</sub>; the filtrate factor or chick pellagra factor, and pellagra-preventive vitamin or black tongue preventive factor. All these four factors of vitamin B<sub>2</sub> complex have now been identified with pure chemical substances. The chemical constitution of all these factors is known. Vitamin B<sub>6</sub> is being synthesized chemically (Harris and Folkers, 1939). It is 2-methyl-3-hydroxy-4-5-dihydroxymethyl pyridine. The chick anti-dermatitis factor has been identified with pantothenic acid, which is (+) α. γ-dihydroxy-β-β-dimethyl-butyl-β'-alanide (Stillier *et al.*, 1940). Lastly the pellagra-preventive factor is identified with nicotinic acid or its amide. The

structural formulæ of these four factors are shown below:—

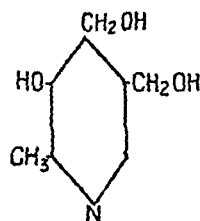


Lactoflavin (vitamin B<sub>2</sub>).

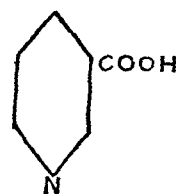


Pantothenic acid

[ (+) α. γ-dihydroxy-β-β-dimethyl-butyl-β'-alanide.]



Vitamin B<sub>6</sub>  
(2-methyl-3-hydroxy-4-5-dihydroxymethyl substituted pyridine).



Nicotinic acid.

**Chemical identification of the P-P factor with nicotinic acid.**—As in the case of other vitamins, the discovery of the vitamin nature of nicotinic acid has been rendered possible only by the intense studies conducted with purified substances on small laboratory animals. Nicotinic acid was first isolated by Funk in 1913 from rice polishings, and he believed the substance which cures polyneuritis to be a combination of nicotinic acid with a pyrimidine base. After the work of Funk there was no important advance made in the possible rôle of nicotinic acid in living systems until the work of Warberg and Christian (1935) who found that the hydrolysis products from the coenzyme which he had isolated from red corpuscles of horse blood, contained nicotinic acid amide. Later, the importance of nicotinamide in the field of nutrition was recognized by Euler and Malmberg (1936) who found that although the addition of nicotinic acid or nicotinamide to a diet supplemented with a vitamin B<sub>1</sub> and flavin did not affect the growth in rats, those receiving the nicotinic acid were found to live longer than the controls. Frost and Elvehjem (1937)



obtained a definite growth response in rats fed on rations supplemented with adenine nucleotide and nicotinic acid. On the other hand a number of workers (Miller and Rhoads, 1935; Birch *et al.*, 1935, 1937; Harris, 1937) have reported that rats can survive and thrive well on diets which may produce pellagra in human beings. Shourie and Swaminathan (1940) conclude that the rat can synthesize nicotinic acid. Others (Macrae and Edgar, 1937; Cook *et al.*, 1937; Dann and Subbarow, 1938) were unable to show that nicotinic acid and its derivatives are dietary essentials for rats.

The period between 1937-38 witnessed important developments in the rôle of nicotinic acid in human nutrition. Elvehjem and his associates of the University of Wisconsin (Elvehjem *et al.*, 1937; Woolley *et al.*, 1938) found that liver extract cured black tongue in dogs and that nicotinic acid was found to be the active principle or the 'pellagra-preventive factor' in the extract. They tested a number of pyridine derivatives for their effectiveness in the treatment of dogs suffering from black tongue, a condition which has for a number of years been considered analogous to human pellagra. The results indicate that a highly specific structure is required for anti-black-tongue potency. Only those compounds, which are converted to nicotinic acid by oxidation or hydrolysis in the animal body, were found to be effective in curing black tongue. Thus ethyl nicotinate, nicotinic acid, N-diethylamide, nicotinamide glucoside iodide and nicotinuric acid were active when given orally, while trigonelline, nicotinamide methochloride, pyridine, pyridine- $\beta$ -sulfonic acid, 6-methyl nicotinic acid, -acetyl pyridine, quinolinic acid, picolinic acid, iso-nicotinic acid, nipecotic acid, and nicotinonitrile were inactive at levels three to four times higher than the curative level of nicotinic acid. The  $\alpha$  and  $\gamma$  isomers of nicotinic acid (picolinic acid and iso-nicotinic acid) were also found to be inactive. Thus it is clear that all those compounds in which one of the ring hydrogens had been substituted by a methyl or carboxyl group, or in which a methyl group had been added to the ring nitrogen, were inactive. As soon as the efficacy of nicotinic acid in the treatment of black tongue in dogs was established, nicotinic acid has been used in the treatment of pellagra in human beings and has been found to be very efficient. During the past three years nicotinic acid has been used in treating hundreds of cases of pellagra and dramatic results are reported within 24 hours after its administration (Smith *et al.*, 1937; Fouts *et al.*, 1937; Spies, Cooper and Blankenhorn, 1938). It is now firmly established that nicotinic acid is a vitamin which is an essential dietary constituent for human beings. Monkeys and dogs resemble human beings in requiring the provision of nicotinic acid, while rats are relatively insensitive to shortage of this vitamin.

*The prevention and treatment of pellagra in human beings.*—The disease pellagra is the condition in man which is associated with nicotinic acid deficiency. The term 'pellagra' means 'rough skin', which is the outstanding symptom of the disease. It is a non-contagious disease, occurring at any age in either sex. It is more common in the poorer classes. The principal symptoms of the disease arise from the skin, the gastro-intestinal tract and the nervous system. In very advanced stages of the disease the classical 'three D's'—dermatitis, diarrhoea and dementia—are present. Such classical cases of pellagra are very uncommon, and all these symptoms may not occur together.

*The skin.*—Typical skin lesions are very characteristic of pellagra. The lesions may appear on any part of the skin. In general, however, the skin of the back of the hands, the elbows, the face, the neck, the knees and the feet, are mostly affected. The skin becomes scaly and pigmented, and in the majority of cases the affected areas are bilaterally symmetrical and are distinctly separated from the healthy skin. The affected areas of the skin sometimes cause severe burning and itching. With the advance of the disease, the skin lesion becomes swollen and more red in colour, which may be followed by desquamation of the skin. There are, however, cases of pellagra without skin lesions. Such a type of pellagra is known as 'pellagra sine pellagra' (pellagra without the rough skin).

*The gastro-intestinal tract.*—Characteristic glossitis usually appears early in the course of the disease and is characterized by redness at the tip and lateral margins of the tongue, with swelling. Ulcers may appear along the sides and tip of the tongue. Stomatitis and gingivitis also may develop. Vomiting, diarrhoea, and anorexia are very common.

*The nervous system.*—In the early stages of disease the person suffers from mental depression. Loss of memory, confusion, unrestrained conversation, irritability, headache, insomnia and muscular weakness are the common symptoms of the diseased person.

*Distribution of pellagra in India.*—Cases of pellagra have been reported in India since 1927 (Megaw and Gupta, 1927; Gupta, 1935; Stannus, 1936; Panja, 1935; Sen Gupta *et al.*, 1939; Bajaj, 1939; Swarup, 1930; Lowe, 1931, 1933; Dhayagude and Khadilkar, 1939; Mody, 1935; Raman, 1933; Rau and Raman, 1936; Raman, 1940; Naganna *et al.*, 1941). From the published literature the following figures were collected:—

TABLE  
Reported cases of pellagra in India

|                  |    |    |    |    |
|------------------|----|----|----|----|
| Bombay           | .. | .. | .. | 7  |
| Bengal           | .. | .. | .. | 9  |
| Punjab           | .. | .. | .. | 11 |
| United Provinces | .. | .. | .. | 1  |
| Hyderabad        | .. | .. | .. | 70 |
| Madras           | .. | .. | .. | 40 |

The figures furnished on the incidence of pellagra are undoubtedly lower than the actual incidence of the disease in this country, since there may be many cases which are not diagnosed properly, and even those which are diagnosed are not reported properly. However, pellagra does not appear to be very common in India.

*The ætiology of pellagra.*—Napier (1939), in an excellent review, summarizes the present knowledge of the ætiology, pathology and treatment of the disease. A number of views have been proposed from time to time to explain its cause.

○ *Maize theory.*—This theory is perhaps the oldest and is supported by many workers. As early as 1600, it was observed that certain Indian tribes in America suffered from pellagra, which was attributed to the consumption of maize. In Italy and France the incidence of pellagra followed the introduction of maize. It was, therefore, thought that maize contained a toxic substance which caused pellagra. This view was upheld for several centuries and was later abandoned in favour of dietetic deficiency as the causative factor. More will be said later on the association of pellagra with a maize diet.

○ *The infective theory.*—Another theory has been advanced, namely, that pellagra is caused by an infective organism. This theory was later given up, in view of the fact that no pellagra germ has been isolated and that all attempts to produce the disease by inoculating healthy persons with the blood of pellagrins failed.

○ *Dietary deficiency.*—That pellagra is a disease caused by a deficient diet has now been fully established by the work of several investigators. The classical work of Goldberger and his colleagues in this direction is of great importance. It was in the year 1914-15 that Goldberger and his associates succeeded in the prevention and cure of many cases of pellagra among the inmates of two orphanages, by substituting the rations of corn with liberal amounts of meat, milk and eggs. Later, several experiments were carried out on human beings and it was clearly demonstrated that pellagra could be produced by diet, and could be cured by the introduction of a modified diet. Dr. Goldberger and his associates found that pellagra could be prevented and cured by foods rich in proteins, and they believed that the disease was caused by insufficient or poor protein in the diet. This theory was later proved to be erroneous in view of the fact that the milk protein, casein, did not prevent or cure the disease. They also found that milk, beef, liver, tomatoes, and peas prevent pellagra.

Although it has been recognized for a long time that pellagra is associated with a maize diet, occasional cases of pellagra may occur among populations subsisting on cereals other than maize. As a large scale

public health problem it exists only in countries in which maize is the staple article of diet. For example, in Roumania maize is the staple food and it is found that 5 per cent or more of the population in certain districts in Roumania may suffer from the disease (Aykroyd *et al.*, 1935). In India, however, where rice is the staple article of diet pellagra is very rare and the disease never assumes epidemic proportions. Raman (1940) has reported that the incidence of pellagra was 0.65 per cent of admissions to the medical wards in Vizagapatam. It is clear, therefore, that the percentage incidence of the population must be much less than this. In view of the fact that the administration of nicotinic acid improves or cures the disease, it is natural to expect that pellagra is due to nicotinic acid deficiency in the diet consumed by the population, in the same way that beri-beri is due to vitamin B<sub>1</sub> deficiency in the diet. It is clear, therefore, that the difference in the percentage incidence of pellagra in countries where maize and rice are the staple articles of diet must be due either to the difference in the nicotinic acid contents of the diets consumed, or to some other factors in addition to nicotinic acid deficiency. Recently, Aykroyd and Swaminathan (1940) have thrown important light on this problem. They have shown that whole maize samples, although low in nicotinic acid, are not very different in this respect from various other cereal products. They have compared the nicotinic acid content of a poor maize diet associated with pellagra, (consumed by poor Roumanian families) with that of a typical poor rice diet. The latter was estimated to contain less nicotinic acid (12 mg.) than the former (15 mg.). These findings appear to indicate that the relationship between diet and pellagra cannot be explained in terms of the nicotinic acid content of the diet alone. There must be some difference between maize and rice other than the nicotinic acid content. Further investigation on this point would be useful in throwing more light on the causation of pellagra. Possibly other factors (as yet unrecognized) play a part in the causation of pellagra.

#### *The nicotinic acid content of foods*

*Methods of estimation.*—Since the dietary value of nicotinic acid is established, the estimation of the vitamin in foodstuffs is a matter of great importance. The methods so far available for its estimation may be classified as follows:—

I. *Biological assay.*—The biological assay for the nicotinic acid content of foods is accomplished by the use of black-tongue dogs maintained on Goldberger diet. For details original papers must be consulted (Waisman *et al.*, 1940). The biological method is very laborious and time-consuming.

II. *Chemical methods.*—Recently many colorimetric methods have been suggested for its

determination in foodstuffs. The usual procedure is to extract the vitamin either with alcohol or water, purifying the extract by various methods and finally to estimate colorimetrically the nicotinic acid in the extract.

*Extraction of nicotinic acid.*—Various methods have been adopted by several workers for the extraction of the vitamin from foodstuffs. Kodicek (1940) found that the extraction of cereals by acid gives nicotinic acid values which are much higher than that given by aqueous extracts. He suggested, however, that water extract gives the true nicotinic acid content of cereals. Leong (1940) has compared the various methods for the extraction of nicotinic acid and found that the values obtained from the acid extract and the aqueous extract were within the experimental error. For routine analysis extraction with water two or three times is advocated by many workers (Swaminathan, 1938; Giri and Naganna, 1941).

*Treatment of the extract.*—Very elaborate methods have been adopted by workers for removing the proteins and for decolorizing the extract. Treatment with lead acetate to precipitate proteins and their derivatives, removal of lead by treatment with sulphuric acid, evaporation to a small bulk, hydrolysis with hydrochloric acid to convert the nicotinamide into nicotinic acid, and removal of colour by treatment with charcoal, are the steps suggested by several workers (Swaminathan, 1938; Kringstad and Naess, 1939). The methods so far suggested involve many steps and lack simplicity. The charcoal which is used for removing the colour adsorbs some nicotinic acid which may vitiate the final result. It is also found that the use of lead acetate to remove proteins is unsatisfactory, some nicotinic acid being adsorbed (Ashford and Clark, 1939). Considering these defects and the time involved in carrying out the various steps, any simplification of the procedure would greatly increase the value of the methods. Recently the present writer has suggested a new method (Giri and Naganna, 1941), based on adsorption and elution of nicotinic acid, by which estimations can be carried out in a much shorter time. The steps involved in the method are extraction with water, hydrolysis with sodium hydroxide to convert the nicotinamide into nicotinic acid, and adsorption upon medicinal charcoal and elution in alcohol-sodium hydroxide solution. By adopting this procedure almost colourless solutions are obtained. Recently Friedemann and Barborka (1941) have suggested a simple procedure for the decolorization of acid digestion mixtures for the determination of nicotinic acid. The method is based on the adsorption of the colour by zinc hydroxide. By following this procedure clear and colourless solutions from blood, urine and tissues have been obtained.

*Estimation of nicotinic acid.*—All of the recent colorimetric methods for the determination of nicotinic acid and its derivatives in biological materials are based either on Vongerichten's

reaction with dinitrochlorobenzene (Vongerichten, 1899) or Koenig's (1904) reaction with cyanogen bromide and an aromatic amine. The following reagents have been proposed by various workers for the estimation of nicotinic acid:—

1. *2:4-dinitrochlorobenzene* was used by Karrer and Keller (1938, 1939) and by Vilter *et al.* (1938). It gives a colour reaction with pyridine derivatives (Vongerichten, 1899; Zincke, 1904).

2. *Aniline* was used by Swaminathan (1938), Kringstad and Naess (1938, 1939), Shaw and Macdonald (1938), Pearson (1939), Ritsert (1939), Leong (1940), Melnick and Field (1940) and Kochhar (1940). It produces a colour reaction of the type described by Koenig (1904) and Strafford and Parry-Jones (1933), *i.e.*, pyridine derivatives react with cyanogen bromide plus an aromatic amine to yield a coloured substance.

3. *Metol (p-methylaminophenol sulphate)*. Bandier and Hald (1939) have used metol instead of aniline. The method has been employed to analyse samples of yeast. This reagent has been used by other workers with slight modification for the determination of nicotinic acid in urine (Rosenblum and Jolliffe, 1940).

4. *Naphthylamine*. This reagent was used by Barta (1935) and with slight modification by Euler *et al.* (1938).

5. *p-aminacetophenone*.—This reagent was introduced by Harris and Raymond (1939a, b) and was used as the aromatic amine for the Koenig reaction. It has since been used by various workers for the estimation of nicotinic acid in foodstuffs, animal tissues and blood (Kodicek, 1940; Giri and Naganna, 1941a; Arnold *et al.*, 1941). It possesses many advantages over the other reagents mentioned above. It is quite a specific for nicotinic acid and its amide; it is about 3 to 5 times as sensitive as aniline and metol; the colour is relatively stable if kept protected from light and the colour can be extracted with ethyl acetate (Arnold *et al.*, 1941).

*III. Methods based on the growth of micro-organisms.*—In blood, nicotinic acid has been estimated quantitatively by its growth-promoting action on various micro-organisms (Querido *et al.*, 1939).

#### *Nicotinic acid content of foods*

A knowledge of the nicotinic acid content of foodstuffs is a matter of great importance from the point of view of human nutrition. With the introduction of chemical methods for the estimation of the vitamin recently the analysis of foodstuffs with respect to this vitamin has been carried out in various laboratories. The values obtained by various workers for the nicotinic acid content of more important foodstuffs are tabulated in the accompanying table.

A study of the figures presented in the table reveals many points of interest. It will be seen that although nicotinic acid is widely

distributed among many natural foodstuffs, only a few of them can be considered to be rich in this vitamin. Among the foodstuffs yeast is the richest source of the vitamin.

The nicotinic acid content of cereals is of special interest as they constitute the staple article of diet in India. Like vitamin B<sub>1</sub>, nicotinic acid in rice grain is concentrated in the germ and pericarp. The polished rice, therefore, contains less nicotinic acid than unpolished rice. It has been shown that two-thirds of the nicotinic acid is lost when the rice is milled. On the other hand parboiled rice loses less of nicotinic acid on pounding and milling. Rice bran is very rich in this vitamin, containing 28 mg. per 100 grammes of the material. Rice kernel furnishes by-products which are a good source of the anti-pellagra factor. The germ layer which contains approximately 15 mg. per cent nicotinic acid is a much better source of this factor than wheat germ. Rice bran ranks close to yeast as a source of the anti-pellagra-factor (Arnold *et al.* 1941). Among cereals Italian millet is very poor in this vitamin. No other cereal grain has given such a low value. This millet is consumed by the poorer classes in certain parts of South India. Among animal products, liver is the richest source of the vitamin, containing more than 10 mg. of the vitamin per 100 grammes of the fresh tissue. The nicotinic acid content of beef, pork and mutton varies between 3 and 4 mg. per 100 grammes of tissue. Among fish, salmon is found to be rich in this vitamin. Prawns and crab are also comparatively good sources of the vitamin. The nicotinic acid content of the muscle tissue of a number of Bengal fish is found to be less than 1.0 mg. per 100 grammes of fresh muscle (Saha, 1941).

Milk and milk products are very poor sources of this vitamin. Although milk has always been regarded as a good source of the pellagra-preventive factor (Wheeler and Sebrell, 1933; Sebrell, 1934), recently several workers have reported very low nicotinic acid content of milk by chemical methods (Kodicek, 1940; Leong, 1940; Swaminathan, 1941). Goldberger and Tanner (1924) found that a daily addition of 40 ounces of butter-milk to a basic diet was sufficient to prevent pellagra. Recently, however, Harris and Kodicek (Kodicek, 1940) have shown that dogs which were kept on black-tongue-producing diet did not show any improvement even after doses of 120 c.cm. of fresh milk per kg. of body-weight. This finding confirms the results obtained by chemical tests. Even human milk is found to be deficient in this vitamin. These results raise problems of great interest from the point of view of nicotinic acid requirements of the child and its relation to the metabolism of growing children. Infants require nicotinic acid for the formation of coenzymes in the body. Since milk does not provide enough of it, it would be interesting to know whether the nicotinic acid is stored in the

body of the new-born child or whether it is being synthesized in the body.

Fruits and vegetables are negligible sources of nicotinic acid, containing less than 0.5 mg. per 100 grammes.

*Human requirements of nicotinic acid.*—Accurate figures are not available for the nicotinic acid requirements. But various clinicians have suggested values between 15 and 25 milligrammes per day. The daily consumption of one pound of unpolished rice will supply this amount. On the other hand the consumption of polished rice may not supply the necessary amount of the vitamin.

*Treatment of pellagra.*—Pellagra can be treated effectively by the administration of nicotinic acid, nicotinic acid amide or sodium nicotinate, either orally or parenterally, in physiological solution of sodium chloride. With regard to dosage it has been suggested that 500 milligrammes daily, administered orally in 50-milligramme doses, is a safe and effective dose for the average case of pellagra. In mild cases a daily dose of 50 milligrammes and in severe cases 1,000 milligrammes per day have been suggested (Spies *et al.*, 1939a). Nicotinic acid can be administered with safety in doses up to 0.3 gm. daily. The administration of large amounts of nicotinic acid to human beings is followed by marked flushing of the face, itching and tingling sensation of the skin.

The administration of liver extract in very liberal doses, yeast and foods rich in nicotinic acid is useful in treating mild cases of pellagra. A daily dose of 15 to 30 gm. of dried powdered yeast is found to cure pellagra, and the practical method of administration is in the form of pure dried powdered yeast, which may be conveniently given admixed with milk.

#### *Some important biochemical changes in pellagrins*

Changes in blood proteins, sugar, urea, Ca and P in pellagrins have been investigated by several workers, and in general it is found that blood proteins are low in pellagrins, while the other constituents occur in normal amounts.

*Porphyria in pellagra.*—Disturbance of porphyrin metabolism is considered to be an important part of the pellagra syndrome, as indicated by the excretion of large quantities of porphyrin and porphyrin-like substances in urine (Beckh *et al.*, 1937; Spies *et al.*, 1938) and the determination of the presence of these metabolites in the urine is considered by some workers as an important test for the recognition of pellagra. On the contrary Rosenblum and Jolliffe (1940) have shown that porphyria is of no value as a diagnostic or therapeutic aid in pellagra. They suggest that porphyria, when present in pellagra, results from coincident liver damage. Recently, Passmore *et al.* (1940) have shown that the urinary porphyrin excretion of persons living on a poor rice diet with a low nicotinic acid intake and showing signs of

stomatitis and glossitis was within normal limits.

*Nicotinic acid, coenzymes.*—The excretion of nicotinic acid in pellagrins is greatly diminished (Naganna *et al.*, 1941). Similarly the concentration of cozymase, an enzyme which is fundamental to cellular respiration, is found to be below normal in the blood and urine of several pellagrins.

*Other vitamins.*—The vitamin B<sub>1</sub> content of urine is diminished in the urine of pellagrins with beri-beri, and the amount of flavin is likewise diminished in pellagrins with riboflavin deficiency. Recently Stanbery *et al.* (1940) have shown that the blood of patients with pellagra, beri-beri and riboflavin deficiency shows a decreased pantothenic acid content. These findings suggest that pantothenic acid is important in human nutrition.

*Multiple deficiencies in pellagrins.*—It has been frequently observed that pellagrins suffer from not only nicotinic acid deficiency, but also from vitamin B<sub>1</sub> and riboflavin deficiency. Peripheral neuritis, which is often associated with endemic pellagra, is due to lack of vitamin B<sub>1</sub>. In such cases both nicotinic acid and vitamin B<sub>1</sub> should be administered. Riboflavin deficiency also occurs in man simultaneously with pellagra. Recently Spies *et al.* (1939) have shown that persons who had been treated successfully for pellagra and beri-beri, but who remained on their deficient diets and were complaining of symptoms such as extreme nervousness, insomnia, irritability, abdominal pain, weakness and difficulty in walking, were treated successfully by the administration of vitamin B<sub>6</sub>. It was found that within four hours after the administration of 50 mg. of pure synthetic vitamin B<sub>6</sub> in sterile physiological solution of NaCl, the patients expressed dramatic relief and increased strength and that the symptoms disappeared completely within 24 hours. One of the persons who had been unable to walk more than a few steps was able to go two miles within 24 hours after the injection of 50 mg. of vitamin B<sub>6</sub>. These findings indicate that vitamin B<sub>6</sub> is important in human nutrition. It is clear from the foregoing, that pellagrins tend to have not only a deficiency of nicotinic acid, but also a deficiency of at least two other vitamins—vitamin B<sub>1</sub> and riboflavin and possibly vitamin B<sub>6</sub> also. It is likely that additional factors may be involved, which can be determined only by further investigations.

#### *Biological rôle of nicotinic acid*

Vitamins have important functions to perform in the chemistry of the cell. In the absence of vitamins, although the cells may still possess the capacity for growth and multiplication, they undergo certain structural changes. The particular cells affected by the deficiency vary with different vitamins. Thus, epithelial cells are involved in vitamin A deficiency, deficiency in

the B complex affects the nerve cells; vitamin C affects all supporting tissue cells and vitamin D the cartilage cells. Nicotinic acid possesses not only the biological function of a vitamin but it also serves as an indispensable catalytic system in cell respiration. Nicotinic acid amide is the constituent of the important catalytic systems in the body known as coenzymes I and II. Coenzymes are those specific substances which increase the activity of enzymes. They are dialyzable and thermostable substances. These coenzymes play a very important rôle in the metabolic processes of the body, and it is of great importance to acquire more information concerning their physiology. Coenzyme I contains one molecule of nicotinic acid amide, two of phosphoric acid, two of pentose and one of adamine, while the coenzyme II contains all the above-mentioned constituents with one more molecule of phosphoric acid. Thus the coenzymes are pyridine nucleotides. The pyridine ring of the nicotinamide is the active group of the coenzyme and acts by alternative addition and subtraction of one molecule of hydrogen. The coenzyme thus acts as a hydrogen carrier through the reversible change.

Pyridine  $\rightleftharpoons$  dihydropyridine.

The coenzymes are components of a number of dehydrogenase systems. The oxidation in animal tissues of many substances, such as lactate, malate,  $\beta$ -hydroxybutyrate, triose phosphate, etc., requires the presence of coenzyme I. The oxidation of these substances occurs as follows:

1. Substance + coenzyme I  $\longrightarrow$  oxidized substance + reduced coenzyme I.
2. Reduced coenzyme I + carrier  $\longrightarrow$  coenzyme I + reduced carrier.
3. Reduced carrier + C<sub>2</sub>  $\longrightarrow$  carrier.

The first reaction is catalysed by enzymes, and the hydrogen is transferred to the coenzyme, which is again oxidized by another special catalyst. This special catalyst which is a new enzyme factor referred to as coenzyme factor or diaphorase (Adler *et al.*, 1937; Dewan and Green, 1937; Euler and Hellström, 1938; Dewan and Green, 1938) has been discovered, which catalyses the oxidation of the reduced coenzyme I by cytochrome and other hydrogen acceptors like lactoflavin, adrenochrome, etc. Recently Straub (1939a, b) isolated from heart muscle a flavoprotein compound which was found to be identical with the coenzyme factor (Corran *et al.*, 1939). This flavoprotein is rapidly reducible by dihydro-coenzyme I and its reduced form is in turn rapidly oxidizable by suitable carriers. Thus the coenzyme factor (diaphorase) is considered to be identical with heart flavoprotein. Although the mechanism of oxidation and reduction is the same in both coenzymes each enzyme is specific for a particular type of dehydrogenase. This coenzyme specificity of the dehydrogenases is an interesting problem in enzyme chemistry, which requires further elucidation.

Coenzyme I is also essential for all oxidation-reductions of alcoholic fermentation and lactic acid formation.

The two coenzymes are distributed in all the tissues of the body. They are also present in blood. Investigations on the relationship between the dietary intake of nicotinic acid and the coenzyme content of tissues have shown that the coenzyme content of the tissues of normal animals (dogs and pigs) remains constant, while in nicotinic acid deficiency there is a definite decrease in the coenzyme content of liver and muscle (Axelrod and Elvehjem, 1939). It is also found that the coenzyme content of the blood varies with the ingestion of nicotinic acid, both in normal individuals and pellagrins. Thus the coenzyme level of the body is reduced in pellagra, thereby reducing the capacity for oxidation-reduction processes in the body.

It is clear from the foregoing account of the biological rôle of nicotinic acid, that the function of the vitamin depends on several factors. The many oxidation-reduction processes in the body which depend mostly on the coenzymes (compounds of nicotinamide) cannot take place in the absence of coenzyme factor or diaphorase, which oxidizes the reduced coenzyme. The coenzyme is again reduced by the dehydrogenase substrate systems in the body, thereby completing the cycle of oxidation and reduction, resulting in the oxidation of many biological materials with the liberation of energy. This coenzyme factor is now shown to be a flavo-protein. Flavin is, therefore, indispensable for the active function of nicotinic acid in the living cell. It is reported that dogs on a black-tongue-producing diet to which substances containing the black-tongue-preventive factor are added, will die unless riboflavin is also present. It is probable that many pathological affections, including those of the skin occurring in animals and men suffering from faulty nutrition, may not be related to any specific deprivation. For example angular stomatitis is very prevalent among poorly fed children in India, and although foods containing the vitamin B<sub>2</sub> complex (yeast) have been found curative; no single member of the group has been found effective when administered in the purified state. Several workers have reported that nicotinic acid alone or with aneurin has not always been found to cure pellagra (Schmidt *et al.*, 1938; Ghalioungui and Hanna, 1938). Vilter *et al.* (1939) have reported that patients who had been cured of pellagra by administration of nicotinic acid and aneurin and were maintained on the pellagra-inducing diet and the above supplements, later developed certain nervous and digestive symptoms which were cured by the administration of riboflavin. These studies, together with many other findings by several workers, provide convincing evidence that pellagra is very complicated and is frequently the result of multiple deficiencies. It appears, therefore, that nicotinic acid is either the pellagra-preventive factor, or

a provitamin or it is one of the factors that are necessary for the prevention of symptoms associated with pellagra.

#### Nicotinic acid content of foods

| Name  | Milligrammes of nicotinic acid per 100 grammes  |
|---|---|
| <i>Cereals and pulses—</i>                  |   |
| Rice (hand pounded)                         | 2.1-4.4 (G.N.), 6.0 (L.).   |
| " (parboiled, home pounded).                | 2.7 (S.), 3.0 (S.2).  |
| " (milled)                                  | .. 3.2 (G.N.), 2.0-2.4 (S.), 0.9 (L.), 1.7 (K.).  |
| " germ                                      | .. 15-16 (A.).  |
| " bran                                      | .. 28, 29 (A.).   |
| Wheat ..                                    | 3.1 (G.N.), 5.3 (S.1), 2.4 (L.).  |
| " germ (defatted)                           | 3.4 (A.).   |
| Barley ..                                   | 3.5 (L.).   |
| Ragi ( <i>Eleusine coracana</i> ).          | 1.6 (G.N.), 3.1 (S.1).  |
| Cholam ( <i>Sorghum vulgare</i> ).          | 2.2 (G.N.), 1.8 (S.1).  |
| Cambu ( <i>Pennisetum typhoideum</i> ).     | 3.2 (G.N.), 2.5 (S.1).  |
| Maize ( <i>Zea mays</i> ) ..                | <0.6 (G.N.), 0.66-1.48 (S.1), 0.6-0.8 (K.), 1.4-2.2 (L.).   |
| Italian millet ( <i>Panicum italicum</i> ). | Traces (G.N.), 0.6-0.8 (S.2).   |
| Pea-nut (shelled, unroasted).               | 5.9 (L.).   |
| Pea-nut meal (ether extracted).             | 22 (A.), 16.6 (S.1).  |
| Black gram ( <i>Phaseolus mungo</i> ).      | 2.3 (G.N.).   |
| Green gram ( <i>Phaseolus radiatus</i> ).   | <0.4 (G.N.), 0.8 (L.).  |
| Red gram ( <i>Cajanus indicus</i> ).        | 2.4 (G.N.), 5.3 (S.1), 0.4 (L.).  |
| Bengal gram ( <i>Cicer arietinum</i> ).     | 2.7 (G.N.), 4.7 (S.1).  |
| Soya bean                                   | .. 4.8 (S.1), 1.2 (L.).   |
| Peas (dry)                                  | .. 1.0 (S.1).   |
| Fruits and vegetables ..                    | <1.0 (L.).  |
| Yeast ..                                    | 36.7-45.5 (B.H.), 43 (M.F.), 29-41 (A.), 60.6 (G.N.), 57.1-62.5 (S.1), 15.2-26.0 (L.), 44.5 (K.N.). |
| <i>Meats and meat products—</i>             |   |
| Mutton ..                                   | .. 4.1 (L.).  |
| Bacon ..                                    | .. 4.4 (L.).  |
| Beef ..                                     | .. 2.1-3.8 (L.).  |
| " liver                                     | .. 9.2 (A.), 7.7-25.0 (L.), 17.0 (K.), 8.6 (G.N.), 20.2 (W.E.), 20.0 (K.N.), 12.2 (B.).             |
| " muscle                                    | .. 2.4-2.5 (A.), 4.0 (G.N.), 4.8 (W.E.), 4.9 (K.N.), 4.3 (K.), 4.9 (B.).                            |
| " kidney                                    | .. 5.8 (L.), 4.4 (G.N.), 6.5 (B.).  |
| " brain                                     | .. 4.3 (K.), 2.4 (G.N.).  |
| " heart                                     | .. 4.9 (G.N.), 5.9 (B.).  |
| " spleen                                    | .. 3.2 (G.N.), 4.4 (B.), 4.7 (W.E.).  |
| Sheep's liver                               | .. 10.1 (G.N.), 12.5 (S.), 15.2-25.2 (L.), 20.0 (K.).   |

A. = Arnold *et al.* (1941).

B. = Bandier (1939).

B.H. = Bandier and Hald (1939).

G.N. = Giri and Naganna (1941, 1941a).

K. = Kodicek (1940).

L. = Leong (1940).

M.F. = Melnick and Field (1940).

S.1 = Swaminathan (1938).

S.2 = Swaminathan (1941).

Sa. = Saha (1941).

W.E. = Waisman and Elvehjem (1941).



## Nicotinic acid content of foods—concl'd.

| Name                        | Milligrammes of nicotinic acid per 100 grammes |
|-----------------------------|--|
| Sheep's muscle ..           | 4.3 (K.), 2.8 (G.N.).                          |
| " kidney ..                 | 7.5 (K.), 6.0 (G.N.).                          |
| " brain ..                  | 3.2 (G.N.), 2.6 (L.).                          |
| " heart ..                  | 4.4 (G.N.), 8.7 (L.), 6.0 (K.).                |
| " spleen ..                 | 3.8 (G.N.).                                    |
| Pig's liver ..              | 16.0 (G.N.), 28.2 (W.E.), 11.8 (B.).           |
| " muscle ..                 | 2.6 (L.), 6.2 (G.N.), 5.3 (W.E.), 4.7 (B.).    |
| " kidney ..                 | 7.2 (G.N.), 6.8 (B.).                          |
| " brain ..                  | 6.4 (G.N.).                                    |
| " heart ..                  | 7.3 (G.N.), 5.3 (B.).                          |
| " spleen ..                 | 5.3 (G.N.), 4.0 (B.).                          |
| Fowl liver ..               | 6.2 (G.N.), 7.2-11.2 (L.).                     |
| " muscle ..                 | 4.2 (G.N.).                                    |
| Eggs (duck or hen) ..       | 0.2-0.3 (L.).                                  |
| Egg, white ..               | <0.05 (K.).                                    |
| " yolk ..                   | 0.10 (K.).                                     |
| Milk and milk products—     |  |
| Cow's milk ..               | 0.1 (L.), <0.1-0.5 (K.), 0.82 (W.E.).          |
| Human milk ..               | <0.1 (K.).                                     |
| Skimmed milk powder ..      | 1.2 (L.), 1.0 (S2).                            |
| Fish—                       |  |
| Salmon ..                   | 8.4 (K.).                                      |
| Herring ..                  | 4.0 (K.).                                      |
| Prawn ..                    | 2.9 (L.).                                      |
| Cuttle fish ..              | 0.9 (L.).                                      |
| Cod ..                      | 3.0 (K.).                                      |
| Fresh fish muscle tissue .. | 0.32-1.0 (Sa.).                                |

- A. = Arnold *et al.* (1941).  
 B. = Bandier (1939).  
 B.H. = Bandier and Hald (1939).  
 G.N. = Giri and Naganna (1941, 1941a).  
 K. = Kodicek (1940).  
 L. = Leong (1940).  
 M.F. = Melnick and Field (1940).  
 S.1 = Swaminathan (1938).  
 S.2 = Swaminathan (1941).  
 Sa. = Saha (1941).  
 W.E. = Waisman and Elvehjem (1941).

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## MINOR DRUG HABITS OF INDIA

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### PART II

#### Group II. Food and dietetic preparations, vitamins and salts

[Continued from last issue]

THE foods which can be used for stimulating and 'doping' purposes are those which are easily accessible and are quickly assimilated so as to provide readily extra calories for increased energy output. They include special artificial foods intended for consumption immediately before or during mental or physical exertion as they have a favourable effect upon the intellectual or muscular performance. A well-balanced diet should act like a tonic and stimulant.

The average balanced diet for an adult in this country aims at an energy output of 3,000 calories. It should contain 398 grammes of carbohydrate, 112 grammes of fat, and 90 grammes of protein. The mineral contents of the diet are also important; they should contain 0.90 gramme of calcium, 1.25 grammes of phosphorus, and 15 to 20 milligrammes of iron. When these requirements are not fulfilled there may be a feeling of exhaustion and hence the need for artificial stimulation. The best method, therefore, would be to supply these requirements in sufficient quantities or in excess, if a greater output of energy is to be expected. Carbohydrates are considered to be most suitable if increased muscular activity is the object. Recent experiments have shown that during muscular effort, there is a drop in the sugar content of the blood which is due to using up the reserve carbohydrates in the body. Further, it has also been proved experimentally that protracted muscular effort induces hypoglycemia which may lead to such an advanced degree of exhaustion that the work may have sometimes to be stopped. When, however, glucose or a hot cup of tea containing a lot of sugar is consumed, the physical capacity of such an exhausted individual is again

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replenished. Thus we find that it is quite common in India to take glasses of sharbat (syrup in water), i.e., drinks containing a lot of sugar in solution in between hard physical efforts especially during the hot weather. Ordinary sugar appears to act as effectively as glucose.

Lecithin is well known for its stimulating effects and eggs, which are very rich in this substance, are therefore commonly used for this purpose. Doubts have been expressed by some authorities as to the efficacy of lecithin when given by mouth. It is believed that this substance is decomposed in the gut and is not absorbed. We have found that ovo-lecithin when given to opium addicts by mouth or parenterally in the form of a 2 per cent solution, greatly ameliorated the withdrawal symptoms, the sense of exhaustion and general depression, during the period of abstinence.

In addition to the proximate principles, a balanced diet should contain 3,000 to 5,000 international units of vitamin A, 400 international units of vitamin B, 250 international units of vitamin C and an undetermined amount of vitamin D, a day. An adequate supply of vitamin A in the diet is essential for satisfactory growth in childhood, and for maintenance of normal resistance against infection. Decreased sensitivity of the retina and night blindness are common results of vitamin-A deficiency, and recent work has shown that the Indian dietary is deficient in vitamin A. The poor classes in India usually have very little fat in their diet. This vitamin is now available in concentrated form in such preparations as Adoxalin but it is very expensive.

Vitamin B plays an important rôle in our daily diet. It has been established that the typical Indian diet contains 160 international units of vitamin B, while a well-balanced diet should contain at least 400 international units. Partial deficiency of vitamin B causes wasting of the gastro-intestinal tract, and lack of appetite and atony of gastro-intestinal tract are well-known sequelæ of the vitamin-B deficiency. Persons with gastro-intestinal atony, and especially with achlorhydria, often have a vitamin-B deficiency in spite of the usual balanced diet. In such cases improvement in general functional capacity follows the addition of vitamin B to their diet. The common practice with athletes and sportsmen is to take an orange or other fruit at intervals between the periods of exertion. Vitamin B plays an important part in carbohydrate metabolism. The more sugar or starch we eat, the more vitamin B we need to oxidize it. Naturally oxidation of sugar is necessary not only for the use of the central nervous system, but also for the muscles. When the voluntary muscles are fatigued we rest them, but there is one muscle that cannot rest and that is the heart, therefore, its need of vitamin B is more urgent. Heart failure is common in weak, debilitated, over-worked and fatigued individuals and those who constantly use alcohol and other drugs as stimulants. This can often be remedied promptly by large doses of vitamin B. Some authorities have observed that by the administration of yeast extract, the glycogen content of the liver and muscles can be increased. The diet of athletes and those who have to undergo hard physical strain should, therefore, contain an adequate allowance of this accessory food. No direct increase in the physical efficiency should be expected from an excess of vitamin B, apart from proper regulation of the carbohydrate metabolism, which is essential during muscular exercise. There are at present many preparations such as Bemax, Betaxin (Bayer), Betabion (Merck) by which vitamin B can be administered in a concentrated form. They have a special value in cases of anæmia, debility, gastro-intestinal disturbances, fatigue, and the sense of depression produced in such conditions as epidemic dropsy. Vitamin B is of value in relief of anorexia and also aids in the assimilation of food. It helps in promoting normal growth in infants, and it is essential for the prevention and treatment of some forms of polyneuritis, in which condition there is definite disinclination for exertion. Vitamins are not likely to cause injury to the system, except vitamin A which given in excess may lead to toxic effects.

Vitamin C also plays an important part and there are quite a number of conditions which are attributable to the lack of this substance, the chief among them being scurvy. Most of the Indian dietaries are adequately supplied with this vitamin.

Vitamin-D deficiency produces rickets, which is not so common in India as in temperate regions. There are certain areas in crowded towns, such as Bombay, where rickets and osteomalacia occur. Vitamin D in concentrated form is sold as irradiated ergosterol.

The use of vitamin preparations as dopes is becoming increasingly popular in this country and a large number of vitamin preparations are on the market. It must, however, be realized that their utility is limited in India. The dietaries in many parts of the country are deficient in proteins and fats, but green vegetables are available in most places. Although the vitamin content is generally adequate in diet for normal requirements, there is always need for extra supplies, either through natural sources or through vitamin preparations, to meet such periods of emergency as pregnancy, lactation, and infancy, when growth is rapid. A little excess of vitamins consumed will not do any harm, but may be beneficial when extra demand arises. Excessive use of concentrated vitamin preparations such as are being prescribed by medical men and are even being used by the laity habitually, cannot do any good and although the effects of excessive indulgence in case of all vitamins have not been worked out, the possibility of their doing harm cannot be overlooked. It should be realized, however, that the amount of vitamins required to preserve normal health is very small, perhaps a fraction of a milligramme a day. Doping with large quantities of concentrated preparations may, therefore, not only do no good, but may do harm.

**Phosphates.**—In this country phosphates are commonly used in the form of Grimault's syrup which contains hypophosphates of lime, and those who take this preparation find it soothing to their nerves and imagine it improves the general tone of the body. Such persons are generally asthenic with weak constitutions.

Phosphates when given by mouth produce a feeling of freshness, well-being and inclination for work, which may amount to euphoria. But when taken in large doses they may produce sleeplessness and diarrhoea. In Europe the most common preparation which is used for such purposes is a form of primary sodium phosphate 'Recresal'. Recresal was used by Poppelreuter himself for several years in daily doses of 3 to 20 grammes, and he felt much better during the period he used this drug. When it was stopped he felt discomfort and disinclination for work. Apparently phosphates improve the general tone of the nervous system, but it is difficult to make any definite assertion from the above experiment as suggestion may also play some part. The dosage used by this worker varied from 5 to 8 grammes per day.

**Calcium.**—Salts of calcium are reputed to improve muscular energy. It has been found that the output of isolated muscles can be greatly improved by addition of calcium salts to the perfusing solutions. Calcium deficiency is frequently seen in some Indian diets, especially those of the South Indians, and it is often supplemented by taking a paste made of lime with betel or by itself. Calcium plays an important part in the body metabolism and its deficiency may lead to serious consequences. Calcium ions are present in all the body tissues and have an important function in maintaining the proper permeability of the cell membrane and normal neuromuscular excitability. Deficiency of calcium gives rise to poor appetite and defective nutrition as well as increased nervous and muscular irritability. Besides the above conditions where calcium is deficient, there are other cases with a normal calcium level in the blood, which are also likely to improve by its administration. They are highly strung nervous individuals who have hyperactive reflexes and crave for stimulation. These persons frequently over-indulge in such stimulants as coffee, tea, opium, cocaine and hydrotherapy. The present authors have found that such individuals were benefited by

taking calcium gluconate although the calcium content of the blood was normal.

Doping with calcium salts, such as is found in South India, has a rational basis, but it is often carried to excess and may lead to harmful effects.

*Sodium chloride and alkalis.*—Alkalies can be taken with advantage during heavy physical strain and are commonly given in the form of sodium carbonate. It is believed that during muscular effort there is a fall in the blood alkali reserve, due to lactic acid production. This is a question which still requires investigation; no definite opinion on it can be given.

During strenuous physical exertion, especially in hot weather, there is a great drain of salts from the body fluids, more particularly sodium chloride; this may be so excessive as to produce symptoms described as stoker's or miner's cramps. In such cases, addition of extra salt to the diet ameliorates these symptoms. People who are in the habit of doing hard physical work under conditions of extreme heat often get into the habit of doping themselves with large quantities of common salt. This undoubtedly is useful, but should not be carried to excess.

*Laxatives.*—In these days newspapers and magazines are full of many attractive advertisements of a number of laxative drugs. The mode of life in large towns, lack of exercise and the general dietary of the people lead to sluggish action of the bowels, and constipation is the result. Laxative drugs are, therefore, used habitually by many people and we know many individuals who take a dose of salts or such laxatives as cascara sagrada or senna, daily, to keep themselves fit. These are examples of border-line cases of drug habit. In many of these cases a large psychological element can be demonstrated, the patient feeling miserable and unwell unless he takes his usual dose. With proper regulation of diet and exercise such persons can easily stop the habitual use of such drugs.

### *Group III. Substances used as accessories to foods: purine derivatives*

It is well known that caffeine and other purine derivatives are widely used as stimulants in connection with physical and mental exertion. They are used either in the form of pure alkaloids or in the form of tea, coffee, or chocolate.

*Tea.*—The use of tea as a stimulating and refreshing beverage is perhaps more common throughout the world than any other substance of similar nature. During the last three or four decades, the habit of tea-drinking has spread through the length and breadth of India, and it has become the commonest of all the beverages used in this country. According to a moderate estimate between 10 to 20 million people in this country take tea habitually.

The earliest reference of the use of tea dates from the year 519 A.D. when it is stated that Darma, who went to preach the Buddhist religion in China, discovered the wonderful properties of the plant. It was not till the end of the sixteenth century that the rest of the world became acquainted with the properties of tea, although it had been extensively employed in China since the fifth century. It is difficult to say whether the knowledge of tea originated in China or whether it came from Assam in India. Towards the end of the eighth century, in the time of the Tang dynasty, taxes on tea were first imposed. At the beginning of the ninth century it reached Japan. Its use as a stimulating beverage spread to Tibet and Mongolia, and thence in a westerly direction to Europe. In 1616, the East India Company sent two pounds of tea to King Charles II of England, and some time

later one kilogramme was sold there for £3 sterling. In 1636 the first advertisement of tea appeared in the 'Mercurius Politicus' as follows:—'The excellent Chinese beverage, recommended by all doctors, which the Chinese call "teha" and other nations "tary" or "the", is on sale in the Café of the Sultana near the Royal Exchange.' Shortly afterwards tea was praised in Latin verse and found its highest eulogy in a book by a Berlin author:—'A cup of tea is a medium for ensuring health and long life.' The Dutch doctor, Bontekoe, who later became the physician of the Prince Elector of Brandenburg, prescribed one hundred to two hundred cups a day. He himself drank tea day and night.

*Chemistry of a cup of tea.*—The two chief constituents of tea are caffeine and tannin. In addition there are minute quantities of minerals and a volatile oil, which have been identified, but whose action has not been fully determined. The latter is present in very small quantities and is associated with valerianic acid, phenol, pyridin, and certain nitrogenous aromatic substances. All these play an important part in the fragrance of a cup of tea, but their physiological effects appear to be negligible.

Caffeine is the chief alkaloid; it possesses well-known powers of stimulation of the higher centres of the brain and the kidneys causing diuresis. The amount of caffeine in an ordinary six-ounce cup of tea, infused for five minutes, is about one grain, compared with about two and a half grains in the same volume of coffee. A longer brewing does not increase the amount in a cup of tea to any great extent, since caffeine is very soluble, and three-quarters of the amount in the tea leaves are dissolved out in the first three minutes. Hence the addition of fresh hot water to tea, which has already been infused, gives a less stimulating brew.

Tannin is the next most important component to caffeine, and possesses the properties of coagulating proteins and gelatine, to form insoluble tannates; it is responsible for the astringent action of tea. Tannin contained in tea, however, differs both in its chemical structure from ordinary tannic acid and its percentage also varies in different brands of tea. The tannins of tea are much less astringent than the tannic acid of the pharmacopœia. The quantity of tannin in an ordinary cup of black tea is about two grains, often less. A five-minute brewing extracts about one-third of the tannin; a longer brew increases the amount, but only to small extent. Tannin is a most important factor, being responsible for the colour, pungency, and 'briskness' of tea. Some teas, however, contain much less tannin than others, but have qualities such as aroma and fragrance which still keep them in the class of good tea. The caffeine content varies less than the tannin. Chemical analysis cannot be depended upon as a guide to the quality of a tea. The tea taster's sensation is more important in judging a particular sample of tea than anything else.

The writers carried out investigation themselves and on a series of persons to find out the effects of different kinds of tea and the effects of brewing for varying periods. Two forms of tea were used: (a) good Darjeeling and Assam tea, and (b) a cheaper brand of the above. An equal quantity weighing about 40 grains, was used in each case with an equal amount of boiling water and each was allowed to brew for five or ten minutes, as the experiment required.

It was observed that good tea (Darjeeling pekoe), after five-minute brewing, produced pleasurable effects in almost all cases; except perspiration, no other symptoms were observed. The effect of taking the same brew after cooling produced similar effects without perspiration. With milk and sugar added, the same pleasurable effects were noted. When the tea (Darjeeling orange pekoe) was brewed for over 10 minutes it had a slightly astringent taste but this could be concealed by adding milk and sugar, and it gave rise to similar pleasurable stimulation as in the above case.

In case of cheap loose bazaar tea, after five-minute brewing, the taste was even better than that of the good brand, except in a few cases slight bitterness, a

peculiar taste and slight degree of nausea were observed. When milk and sugar were added, the bitter taste was removed and it gave rise to a pleasant feeling with no other effect. Full effects developed within half an hour of taking it. Roughly speaking, there was 10 to 15 per cent increase in mental and muscular output after using a short infusion of a high grade tea such as orange pekoe. It would, therefore, appear that good Indian tea brewed for five minutes, produces mild and pleasant stimulation, except in those who are hypersensitive to it or who indulge in it to excess. Tea agreeably excites the central nervous system, slightly raises the normal cerebral activity without resulting in a subjective impression of compulsion, i.e., an activity which cannot be mastered by the individual. These favourable effects are seen even in cases where under normal circumstances fatigue would have diminished the active capacity. Besides giving rise to a mild degree of euphoria, tea improves judgment and helps in intellectual work. Strong tea (brewed 10 minutes) may produce some mild discomfort, but the addition of milk hides this. Cheap Indian tea suits the palate of the masses in this country and produces no objectionable effects, but in strong infusion it is apt to be unpleasant. These effects were observed in moderate tea drinkers. There is no doubt that abuse of concentrated infusion of tea is liable to call forth physical disorders of a general nature in persons susceptible to its action.

**Coffee.**—Coffee is a common stimulating beverage used in Southern India, where it has replaced all other beverages. There are millions of people in this country who take this beverage habitually.

Coffee has been known for a long time to the Arabs and the Persians as a substance endowed with marvellous properties. It is said to have been presented by the Archangel Gabriel to Prophet Mohammed when he was sick. It is said that the prior of a Mohammedan convent was told by his shepherds that goats that had eaten the beans of the coffee plant remained awake and jumped and gambolled about at night. This gave him the idea of preparing a beverage for himself and his dervishes in order to keep awake during the long night prayers in the mosque. The beverage was called *kahveh*, i.e., that which stimulates or suppresses the appetite for food. Coffee was used by almost the entire population of Asia Minor, Syria and Persia in the sixteenth century.

Coffee, owing to the presence of 2.6 per cent of caffeine in it, is regarded as a destroyer of care and sorrow. The condition of cerebral excitation may increase with large doses and may produce delirium. Excessive indulgence is liable to give rise to a state of chronic excitation in the form of delirium, vertigo, tremor and even convulsions.

Personal disposition plays a very important part in the manifestation of the undesirable effects of coffee. The evil properties which many persons attribute to coffee and other substances containing caffeine, are nothing but the result of their own constitutions, or innate or acquired idiosyncrasies which evoke in them abnormal reactions. It exercises a gentle stimulating influence on the brain, and in this way the tendency to sleep is diminished. Mental capacity and perhaps also the imagination are agreeably augmented. Coffee inhibits the appearance of fatigue, or at least makes it less perceptible, and in this way tends to increase the capacity for work and general activity without exerting any powerful effect on the cerebral centres. In the same gentle manner the activity of the heart in healthy persons is augmented. As soon as these effects become evident, any feeling of general depression and weakness may be dispersed and the working capacity of the muscles stimulated for a certain time. This state is not succeeded by a subjective feeling of fatigue. It is an open question whether the process of metabolism is modified in any direction, as some have stated. The personal experience of millions of coffee drinkers in all

parts of the world testifies to the stimulating action described.

The habitual drinking of infusion of caffeine-containing plants is not always attended with injurious effects, as it does not in any way disturb the personality of the individual. Coffee exercises a stimulating action on the brain which results in an increased activity, whereas spirits habitually taken have a more or less permanent effect upon the central nervous system. Caffeine beverages, in moderate amounts, do not cause the drinker to deteriorate either physically or mentally. Even in cases where evident abuse of the beverage has taken place, the functional disorders are with a few exceptions soon adjusted. There is an excessive state of brain excitation which becomes manifest by a remarkable loquacity sometimes accompanied by accelerated association of ideas. This state occurs not infrequently at coffee parties where the beverage is indulged in to excess. It may also be observed in coffee-house politicians who drink cup after cup of black coffee and by this abuse are believed to be inspired to profound wisdom on all earthly matters. Daily consumption of very large amounts of concentrated infusions even of pure coffee over a long period must give rise to evil consequences. These are not only due to the aromatic substances formed during the roasting process, such as caffeol, pyridin, furfural, furfuraldehyde, mono- and trimethylamin, etc., but also to caffeine itself. Gastric disorders, headache, a state of nervous excitement with insomnia or restlessness, by which the heart is sometimes affected, may occur. Less frequently a state of general weakness accompanied by depression or trembling of the muscles may be produced. Rarely coffee abuse has been known to cause diplopia or weakness of sight, tinnitus aurium, angina pectoris, dyspnoea, pains in the testicles and prostatitis. It has frequently been stated that the drinking of coffee diminishes sexual excitability and gives rise to sterility.

**Discussion.**—From the foregoing description it appears that infusions from plants containing caffeine and other purine derivatives are widely used as stimulants in connection with physical and intellectual effort. They are used in the form of coffee, tea, or chocolate. Caffeine stimulates the central nervous system; it increases the reflex responsiveness of the motor areas of the cortex and exerts a favourable influence upon mental functions, especially under conditions of intellectual strain. It also shortens the reaction-time to tactile and visual sensory stimuli and accelerates the normal process of association. Although caffeine is an important constituent of A.P.C. powder, which is often taken to relieve fatigue and pain, it is rarely used by itself.

The action of caffeine on the heart is chiefly manifested in an increase of the absolute strength of that organ and in a dilatation of the coronary vessels. Breathing is intensified as a result of the stimulation of the respiratory centre, and ergographic tests performed on particular groups of muscles have shown that caffeine and products containing that substance improve the efficiency of the muscles. In view of its known pharmacological properties, caffeine might be expected to improve mental and physical performance in certain circumstances. This question has been fully investigated by various workers. It has been shown that caffeine had no effect so far as brief physical effort is concerned. After administering caffeine to 46 subjects before a 100-metre race, it was observed that the time recorded was no better. Work tests on the cycle ergometer show, on the other hand, that when caffeine is administered, a large aggregate amount of work can be performed before exhaustion sets in. In tests involving an output of 825 kilogram-metres of work per minute, it was found that after the administration of caffeine (0.2 gm. of caffeine sodio-salicylate), the total time during which the exercise could be continued was extended by a few minutes and that efficiency was somewhat greater.

Tea and coffee are being taken habitually by millions of people in this country. Observations

by the authors show that, taken in moderate quantities, these beverages not only do no harm, but actually are beneficial from the point of view of output of physical and intellectual work. Cases of excessive indulgence are rarely found and even in these we have not seen any serious damage to the system; cutting down the quantities taken at once stopped any untoward symptoms.

The authors have studied the effects of Indian coffee on the circulatory system. Experiments were made on a Punjabi medical student and an athlete who was the winner of all the principal sports items in a tournament. The pulse rate and blood pressure were recorded before and after a half-mile race and other events. It was found that the administration of a cup of coffee did not affect the pulse and blood pressure in any way. The only symptom which was noticed was a feeling of alertness before starting the event. It is not possible to draw from these experiments any conclusion regarding the effect of coffee. Nevertheless, we are of opinion that the excessive use of caffeine-containing beverages before undertaking any physical exertion should not be encouraged.

It is very difficult to determine how far pure caffeine or purine derivatives in the form of coffee, chocolate and cocoa, given to athletes in normal therapeutic doses as a physical stimulant, can endanger their health. But it seems likely that any substance capable of stimulating the body to exertion beyond the limits set by the normal sensation of fatigue will prove injurious.

#### *Betel leaf and areca nut (pan-supari)*

**Historical and general.**—Pan (*Piper betel* Linn.), the chief ingredient of the betel morsel (*pan-supari*), belongs to the natural order *Piperaceæ* and is widely cultivated in Madras, Central Provinces, Bengal, Orissa, Bombay, U. P. and Burma. The use of betel leaf can be traced as far back as two thousand years. It is described in the most ancient historic book of Ceylon, the *Mahavamsa*, which is written in the Pali language. It is mentioned that in the year 504 B.C. a princess made a present of betel to her lover. During the combat between Duthagami and the Malaharis in the year 161 B.C., his enemies seeing his blood-red lips due to chewing of betel, got the erroneous impression of having wounded him.

About 340 B.C. Theophrastus described the areca palm (*Areca catechu* Linn.) the nut of which forms a component of the betel morsel. This palm is also mentioned in Sanskrit under the name of *guvaka* and is referred to in Chinese texts about 150 B.C. as *pinlang*, a Malayan name which it still bears at the present day. Betel was extensively used in India and the Arab and Persian visitors in the 8th and 9th centuries found this habit deeply rooted in this country. The use of betel in Persia, however, is much older. The Persian historian Ferishta writes that there were 30,000 shops for the sale of betel alone, in the capital town Kanvakubia, during the reign of Khosru Parviz (i.e., Chosroes II, A.D. 600). Masudi, who travelled in India in 916 A.D., describes the chewing of betel as a national custom which even those who voluntarily ascended the funeral pyre practised as a final comfort. He also mentions that areca nut was highly valued by the inhabitants of Mecca, Yamen and the Hejaz who substituted it for mastix. Marco Polo (1300 A.D.), who travelled in Central Asia, China, India and Persia, and

Ibn Batuta (1400 A.D.), who visited the whole Mohammedan world, described the growth and the use of betel in India and the bad effects which followed.

**Medicinal properties.**—Pan or betel leaf (*Piper betel*) has been described from ancient times as an aromatic stimulo-carminative (*Katu*), astringent and aphrodisiac. The leaf produces an aromatic phenol called *chavicol* which has powerful antiseptic properties. The alkaloid arakene has properties resembling cocaine in some respects. The betel leaf is believed in as a common household remedy for various ailments. It is sometimes applied over the temporal regions for its analgesic and cooling effects to relieve intense headache. A local application is recommended for inflammatory swellings such as orchitis, arthritis, mastitis.

The application of leaves smeared with oil is said to promote secretion of milk when applied on the breasts of lactating women. In pulmonary affections of childhood and old age, leaves soaked in mustard oil and warmed are applied to the chest in order to relieve cough and dyspnoea. Its local application is considered to be a useful adjunct in the treatment of hepatitis, orchitis and sore throat. The fruit is sometimes mixed with honey and taken as a linctus to relieve irritating throat cough.

**Supari (Puga), i.e., areca or betel nut (*Areca catechu*),** has been used as a stimulant, astringent and a vermifuge (*Kriminashak*). It is also prescribed to increase the flow of saliva, harden the gums and sweeten the breath. It contains tannic and gallic acids, oily matter and three alkaloids. Many people use it habitually as a masticatory without *pan*. The powdered nut is useful in checking diarrhoea and is believed to possess aphrodisiac properties. It is used as an astringent in bleeding gums and for stopping watery discharge from the vagina (*superi-pake*). A piece kept in the mouth allays thirst. The young fresh undried nuts, when chewed by those who are unaccustomed to its use, produce a feeling of faintness and giddiness, owing to the alkaloids. By drying it under the sun or boiling in water these effects are considerably lessened.

**Betel and supari in social life of Indians.**—*Pan-supari* plays an important rôle in the daily social life of Indians. The custom of offering it to guests and visitors is a common courtesy amongst Orientals and has been prevalent in many parts of India from very ancient times and it exists amongst all sections of society to the present day. It is a common custom to offer *pan-supari* before and after meals to guests, and on account of its carminative and sialogogue properties it is a digestive when taken after a heavy meal. *Pan-supari*, especially the *pan*, is very commonly recommended by Ayurvedic physicians to stimulate sexual desire. Partly owing to its aphrodisiac properties and partly on account of its deodorant and exhilarating properties, *pan-supari* came to form a part of the ritual, with which a wife welcomed her husband. This custom still exists to some extent amongst certain sections of society. In some of the religious books of Hindus the duties of a wife are described in the following terms:—

'The housewife must light the lamp and nicely prepare the bed. She must put on clean clothes, apply *sindhura* (vermillion) to her forehead and chew *pan* mixed with the usual spices. She must give him milk boiled with sugar, nutmeg, saffron, almond and musk and also betel nut and spices wrapped in *pan*' (betel leaf).

This use of betel morsel sweetens her own breath and produces exhilaration and aphrodisiac effects in the husband. This custom has spread to prostitutes who offer *pan-supari* to their visitors. The custom of chewing betel morsel is widely prevalent in certain parts and there are many persons in this country who chew it all the time they are awake. It is carried and is offered to friends just as Europeans offer cigarettes. While the leaf possesses aphrodisiac properties the thin stalk is believed to have contrary effects, and is supposed to produce sterility. This is why it is removed when the morsel is prepared.



*Extent of its use.*—No other substance is craved for in the East with the same ardour as a betel leaf. There are many betel chewers who would rather give up their food than forego the betel morsel. The enormous extent of the practice of chewing betel in this country and the large quantities consumed give it an important position amongst accessory food substances. The areas of highest consumption are the eastern and southern parts of the Konan coast, Kanara, the Malabar coast as far as Cape Comorin, Travancore, Ceylon, Coromandel coast, Assam and Bengal. The use also extends to the Central Provinces, the Punjab, the United Provinces and the south-east Himalayas. On the west its use extends right up to the river Indus. According to a moderate estimate there are between 5 to 10 million betel chewers in this country. It is not consumed to the same extent in all parts of the country. Its use, for instance, is more extensive on the east coast than in the interior and northern parts of the country. In parts of the Punjab and North-West Frontier Province, the practice is considered a luxury and it is taken only on festive occasions. The passion for the leaf is common to all, both men and women of all ages, classes and religions. The habit is often started during childhood and may be continued till death. In Assam there are certain tribes who consider that no one can speak Assamese until he begins chewing betel. There are many who chew it at all times, at work or rest.

*Modes of preparation and consumption.*—Betel morsels are not always prepared fresh, but ready-made morsels are kept at home and also for sale in the betel shops. In many households it is regarded as a duty of the female members to prepare and offer it to the family and guests, and a small box containing the implements and ingredients necessary for preparing the morsel is kept ready. The betel leaf is consumed in a fresh state, the old deteriorated leaves are believed to lose their properties. Frequent moistening preserves the plucked leaves and keeps them fresh for weeks; the leaves which by this process assume a yellowish colour are preferred. The betel morsel presented to visitors on ceremonial occasions is composed of a piece of areca nut and a certain amount of burnt lime, a few spices and aromatics, and it is very often covered with gold or silver leaf. Some people add tobacco in addition to the ordinary constituents. In the process of chewing, the morsel is pushed from one side of the mouth to the other, it is masticated, pressed against or between the teeth in order to remove the juice, and it may protrude between the lips. The amount of different ingredients in the morsel differs with individuals. The areca nut constitutes one half or even more of the total weight of the morsel, the balance being made up with betel leaf, spices and lime. Generally one large betel leaf or one and a half of the smaller leaves are used in making one morsel to which half to one grain of lime is added. The maximum amount consumed in one day may amount to two hundred leaves in adults, these contain approximately 20 to 30 nuts; moderate consumers may use from two to ten morsels.

#### *Pharmacological effects of betel chewing*

*Symptomatology.*—The present writers have carefully studied over one thousand individuals who were in the habit of taking betel morsel

habitually. This series included persons of all ages, races and occupations. The following description of the symptomatology from using the betel morsel is based on personal observations recorded in this series:—

The first apparent effect of the process of chewing *pan* is an abundant flow of saliva which mixes with the constituents of the morsel. Some people spit it out while others swallow it. The process of chewing is repeated for some time and in the case of a hard nut, there may be some difficulty in cracking it. The morsel is chewed until only a few ligneous fibres are left, which are thrown out. Persons who are not accustomed to the habit may experience a disagreeable, acrid and burning taste, and a feeling of constriction in the throat just after taking it. It may lead to roughness or even slight ulceration of the tongue and the buccal mucosa. These unpleasant effects are less and less apparent as the individual becomes accustomed to the habit, and they are followed by agreeable sensations and a feeling of well-being. The perception of taste also becomes temporarily dulled on account of the presence of the essential oil contained in the leaves, and to the astringent action of the lime. The red coloration of the saliva is due to the colouring matter of the nut, which manifests itself under the influence of the alkali of the lime. The usual mixture of areca nut, betel leaf and lime imparts a red-brown colour to the saliva, while the morsel containing betel leaf, areca nut, gambir, catechu, and lime gives rise to blood-red colour. After the initial effects of the excitation of the salivary glands and the irritation of the mucous membrane of the mouth have passed off, a pleasant odour lingers in the mouth which is regarded as one of the charms of this habit. Besides the pleasant odour in the breath, the morsel produces a mild degree of general stimulation. In those who are not accustomed to the use of areca nuts a sensation of uneasiness, stifling (sometimes amounting to faintness), tremors and sweating is often produced. The symptoms are not of long duration and disappear within 10 to 20 minutes. The stimulating effects upon the central nervous system are mainly due to the areca nut which contains an active principle, the volatile alkaloid called *arecoline*. This substance produces a state of excitation of the central nervous system, leading to increase of the reflexes and eventually convulsions followed by paralysis. The respiration becomes more frequent and the heart is often slowed. The nervous effects may vary in different individuals and animals according to disposition. Dogs, for instance, after ingestion of areca nut exhibit extreme excitement; frogs on the other hand show symptoms of depression.

The effects may also vary according to the nuts used; raw nuts produce vertigo and a sense of intoxication resembling that experienced after alcohol; with old nuts these effects are not nearly so marked. The variation in the effects produced is due to differences in the arecoline content of the nuts. Besides the active principle of the areca nut, the essential oil of the betel leaf also produces in animals a primary excitation followed by a kind of intoxication. It enhances the effects of areca nut and acts synergistically upon the central nervous system. In addition to the above two main ingredients, the alkaline reaction of the lime plays an important part in liberating the alkaloid arecoline from areca nut. In this way lime also plays an important rôle in enhancing its nervous effects.

*Effect on muscular output.*—The present authors have carried out series of tests to investigate the effect of betel morsel on muscular and mental work, betel morsels with and without areca nuts in the fresh and dried state being used. There was no question of suggestion as the taste was made identical by the use of spices and flavouring agents and the subjects under test were quite unaware of difference in ingredients. The first part of the test consisted in establishing a certain degree of fatigue by riding on a bicycle along a road. Two pieces of betel morsels with different

ingredients were then given, work was resumed after a rest of half an hour, and was pursued until complete exhaustion set in; the time of exhaustion was recorded in each case. The pulse rate and the blood pressure were also recorded in certain cases, and the general condition was noted. The total amount of work done was also noted in different cases. The pulse and the blood pressure were not much affected, but it was found that the working capacity was slightly increased by betel leaf. This was further enhanced by 10 to 15 per cent when the morsels prepared with fresh areca nuts are used.

*Effects on mental* . . . tests were carried out in twenty . . . most of them being clerks and medical students from the Punjab, where the betel morsel is used in moderation.

Three series of experiments were conducted on each individual. In the first series, individuals were asked to add the figure 19 to each of a series of 23 digit numbers selected from a long list of small figures. In the second series of experiments they were asked to multiply two-digit numbers with 6, and add 7. In the third series they had to add 4- to 2-digit numbers, multiply it by 5 and then subtract 12. In each of these experiments the time taken for the calculation was accurately noted with a stop-watch and this was compared with that obtained after chewing 2 morsels of *pan*. Similarly the number of errors committed before and after *pan* chewing was also recorded. The following results were obtained: In experiment I, the average time taken and the number of errors committed in solving the problem before *pan* chewing were 2.98 seconds and 2.25 errors against 2.38 seconds and 1.25 errors after taking two morsels of *pan*. In experiment II, the average time required for solving the problem was 5.2 seconds and the number of errors committed 2.1 before chewing *pan*, whereas these figures were 4.59 seconds and 1.7 errors respectively after taking two *pan* morsels. In experiment III, the time taken for the calculation was 8.7 seconds and number of errors 3 before, and there were 7.25 seconds and 1.7 errors after *pan* chewing. It would appear from these experiments that small and moderate doses of *pan* slightly stimulate the mental faculties, resulting in quicker solution and greater accuracy in arithmetical calculations.

*Pathological changes produced by excessive betel chewing.*—We have examined a series of 400 habitual betel chewers in this country and a brief summary of the findings is detailed in the underlying table. All these individuals were taking more than 20 morsels daily.

TABLE  
*The pathological changes and their relative frequency in habitual indulgers of pan*

| Pathological conditions  | Number of cases | Frequency percentage |
|--|-----------------|----------------------|
| 1. Caries  | 120             | 30.0                 |
| 2. Deposition of black tartar                                    | 218             | 54.4                 |
| 3. Recession of gums   | 82              | 20.5                 |
| 4. Partial or complete loss of sensibility of the buccal mucosa. | 60              | 15.0                 |
| 5. Pyorrhœa alveolaris   | 280             | 70.0                 |
| 6. Dyspepsia   | 160             | 40.0                 |
| 7. Palpitation   | 180             | 45.0                 |
| 8. Neurosis  | 35              | 8.75                 |
| 9. Giddiness   | 20              | 5.0                  |
| 10. Slow cerebration   | 10              | 2.5                  |

The figures given above are considerably higher than those occurring among those who do not take betel leaf habitually.

It would appear from this table that excessive indulgence in betel chewing leads to many pathological changes which are deleterious to health. Dental troubles, oral sepsis, dyspepsia, palpitation, neurosis and slow cerebration are only some of the innumerable mischiefs produced by this habit.

*Cancer of the mouth.*—The excessive use of betel morsel undoubtedly leads to chronic irritation of the lips, mouth and tongue and predisposes to epitheliomatous growths in susceptible individuals. According to Castellani and Chalmers, betel irritation is the commonest cause of cancer of old people in the East. Cancer of the mouth and lips was found to be more frequent in localities where the betel habit was widely prevalent, e.g., Assam, Burma and southern India, than in the northern parts of India where its use was not so popular. Out of 141 cases of cancer among chronic indulgers in *pan* in various hospitals of Bengal, Bihar and Orissa, 18 were cancer of the lips, 3 cancer of the tongue and 120 cancer of the rest of the body. This showed that carcinomatous growths of lips and tongue comprised at least 14 per cent of the total number of cancer cases. Betel-chewing therefore definitely predisposes to carcinomatous growths of the mouth.

*Summary and discussion.*—The authors have studied the ill-effects of betel-chewing in this country and have examined over one thousand people who were habituated to its use. From the toxicological point of view the objections against its use are less serious than those against alcohol and tobacco. Taken as a whole, the ill-effects of betel are milder than those of narcotics. Dutch observers in the East Indies noticed that it was perfectly harmless in moderate amounts. One or two *pan* morsels a day may stimulate muscular and mental efficiency. The chief objection to its use is that once the habit is formed it is difficult to stop it. From this point of view the consumption of betel must be regarded as an evil. The withdrawal symptoms are a general sense of fatigue and exhaustion, possibly from loss of the stimulation reflex. Unpleasant taste in the mouth and disinclination for exertion are often complained of. According to Ahmed (1928) people who are habitual betel chewers become dyspeptic at about the age of 30 years and suffer from pyorrhœa alveolaris with its attendant sequelæ. He was also of the opinion that cancer of the tongue and cheeks frequently occurs in those who indulge in it excessively. Modi (1928) also made similar observations and found that pyorrhœa was very frequent in these cases but dental caries was not very common. There is dulling of sensibility of the buccal mucous membrane, recession of gums, deposition of lime concretions and atrophy of the alveolar processes.

In our series such effects were observed in excessive consumers and not in moderate and occasional indulgers. Another point, which must not be lost sight of in excessive consumers, is that constant stimulation of salivary secretion involves an enormous waste of saliva which is



expectorated or swallowed instead of being utilized for digestive purposes. The fibrous portions of betel leaf and betel nut get into the crevices of the teeth and stay there for some time leading to the formation of pockets. This results in irritation of the gums and inflammation of the alveolar margins, and ultimately pyorrhœa alveolaris results. Another point against the use of *pan* is the concomitant use of *zarda* (an aromatic preparation containing tobacco) which is not infrequent. This irritates the buccal mucous membrane, acts on the nerve endings of the teeth, decreases their sensibility and upsets the gastro-intestinal tract.

The consumption of lime with each morsel may lead to excess of lime in the system, with its accompanying effects; lime is excreted in the saliva and is deposited on the teeth in the form

of yellow tartar which, if not promptly dealt with, leads to infection of the gum. This deposit may also extend to the roots of the teeth and thus lead to the destruction of the periodontal membrane and produce pus pockets. Further, the alkaline juice of the betel morsel is believed to neutralize the gastric acidity and acts as an astringent on the mucous membrane of the stomach. All these effects are observed in excessive chewers and not in moderate and occasional consumers.

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## Medical News

### ECONOMY IN THE USE OF IPECACUANHA AND EMETINE

AMŒBIC dysentery is common in India and accounts for a fair amount of mortality and morbidity, especially amongst the members of the European communities resident in the tropics. In the treatment of this condition, emetine, one of the principal alkaloids of ipecacuanha, is considered a specific and is very largely used.

Ipecacuanha is not indigenous to India. Attempts have been made to grow this plant in suitable localities in India, but the indigenous supply has never been adequate to meet the local demands. India, therefore, remains largely dependent on foreign sources of supply.

Owing to conditions produced by the War supplies of this essential drug have been scarce and irregular. In the interests of the sick, it is desirable that a general effort on the part of medical men should be made to conserve stocks of this important remedy, so that those who really need it will not be deprived of its valuable curative properties.

The extent to which ipecacuanha enters into popular therapeutics is surprisingly large. Much of this is in the form of *Pulvis Ipecacuanhæ et Opii* (Dover's powder), which is almost an everyday prescription in influenza, chill, coryza and slight cough. It is often used to 'abort' an attack of cold and also to check mild diarrhœa. Its diaphoretic and astringent actions are mainly responsible for its popularity. Therapeutically there appears to be no particular advantage in using *Pulvis Ipecacuanhæ et Opii* to bring about these effects. It is the opium in the preparation, and not the ipecacuanha, which brings about the diaphoretic and astringent actions. The astringent action can be very easily obtained, probably more conveniently, by the use of *Pulvis Cretæ Aromaticus cum Opio*. For diaphoresis, practitioners have at their disposal a large selection of coal-tar remedies including salicylates and their derivatives. The use of Dover's powder can, therefore, be conveniently reduced by encouraging the use of various substitutes which may bring about similar clinical results.

A significant contribution towards economy in the use of ipecacuanha may also be made by exercising a little more judiciousness and care in prescribing the galenicals of ipecacuanha, of which *Vinum Ipecacuanhæ* (now *Tinctura Ipecacuanhæ*) is the most widely employed. *Tinctura Ipecacuanhæ* is a common ingredient of sedative expectorant mixtures frequently

seen in the pharmacopœias of various hospitals and out-patients' clinics. *Tinctura Ipecacuanhæ* is neither a very rapidly acting nor always a trustworthy expectorant. In many types of bronchitis, the use of such mixtures is not of any particular advantage and *Tinctura Ipecacuanhæ* may be replaced by *Vinum Antimoniale* or *Tinctura Scillæ*. Only in pediatric practice is there some justification for its continued use in war-time.

*Pulvis Ipecacuanhæ* is gradually going out of fashion but prescriptions are still seen where this has been used either for its emetic or for its cholagogue action. Such uses are a relic of the old days and cannot be supported by rational therapeutics. Ipecacuanha has now been shown to be a poor emetic and its supposed cholagogue action is also doubted by modern pharmacological investigators. Its use in such conditions therefore need no longer be advocated.

Whatever may have been the justification of such haphazard use of ipecacuanha in pre-war days, it is the clear duty of all medical men to stop such practice in these abnormal times when there is a shortage of this essential remedy. If every medical man employs the same rigid criterion in the use of ipecacuanha as they do in the diagnosis of their cases, much waste in the use of the preparations and galenicals of ipecacuanha could be avoided and stocks of ipecacuanha could be reserved for the extraction of emetine, whose value in the treatment of amœbiasis has been fully established.

### MEDICAL RESEARCH IN INDIA, 1911 to 1941

THE establishment of the Indian Research Fund Association in 1911, with the object of prosecuting research into medical problems and experimental work generally in connection with the causation, mode and prevention of disease, was an important event in the history of medical research in this country, states the Public Health Commissioner's report for 1940. The Association has, in the succeeding period of thirty years, fostered research into diverse medical problems, has provided, through its advisory committees on different subjects such as nutrition, malaria, cholera, maternal mortality, tuberculosis, plague and leprosy, expert guidance to health administrations in their day-to-day problems and has, above all, helped to raise a body of workers in the different branches of medical research whose services will continue to be available to the country in the future.

### PAY OF ASSISTANT SURGEONS OF THE EMERGENCY BRANCH OF THE I.M.D. (INDIAN CADRE)

In accordance with one of the recommendations of the I.M.D. Recruitment Conference held in Simla on 23rd September, 1941, the Government of India are pleased to announce that the emoluments of Assistant Surgeons of the Emergency Branch of the I.M.D. (Indian Cadre) will be raised as from 1st December, 1941. The pay will be as heretofore, namely Rs. 75 to Rs. 175, but the former Civil Allowance of Rs. 50 will be replaced by an Emergency Allowance of Rs. 125 p.m. Thus, the initial pay plus emergency allowance will now total Rs. 200 p.m. instead of Rs. 125 as before.

### I.M.S. PERMANENT COMMISSIONS. WAR SERVICE PREFERENCE

OFFICERS holding King's and Indian Emergency Commissions in the Indian Medical Service during the present emergency will be given preference when permanent appointments are made after the war, provided they are qualified under the conditions then in force.

### I.M.S. EMERGENCY COMMISSIONS. ADVANCE OF PAY FOR SELECTED CANDIDATES

THE Government of India have decided that candidates selected for Emergency Indian Commissions in the Indian Medical Service will be allowed to draw advance of pay at the time of appointment, not exceeding Rs. 300 if the candidate has been selected in India and equal to two months pay if in the United Kingdom.

The advance will be recovered from the officer's pay at the rate of one-third of his pay.

### MALARIA

MALARIA is easily the largest public health problem in India. The deaths from this disease number about a million and a quarter every year while the number of attacks may be as high as 100 millions.

The Malaria Institute of India, which is maintained by the Government of India, is an institution which co-ordinates to a large extent the anti-malarial operations conducted by the Central and Provincial Governments. In Delhi, within the last five years, a very successful anti-malaria campaign has been in operation, including the provision of certain permanent engineering works costing Rs. 17,00,000. The incidence of the disease has been reduced to negligible proportions and the mosquito nuisance has been almost eliminated.

A research unit of the institute has completed two years' observation in the Terai area in the United Provinces and the data collected are being analyzed. In Wynaad taluk of Madras Presidency and in the vicinity of the Chilka Lake in Orissa, studies regarding the factors responsible for the prevalence of malaria have been in progress and valuable information has already been collected for instituting preventive campaigns.

### ANTI-MALARIA UNITS

IN consultation with the military authorities six anti-malaria units have been raised for the investigation of local malaria conditions in the war area. A detailed study is essential for the planning of proper measures of control in these areas.

The duties of the units include the identification of mosquitoes, the incrimination of the local malaria carriers by dissection, the study of their bionomics, the study of malaria among the local inhabitants by spleen and blood examinations, the determination of the species of malaria parasite locally present and of the period of the year during which malaria transmission takes place.

Four emergency courses in malaria have been held at the Malaria Institute of India, Delhi, for training military personnel in anti-malarial methods.

### STATE SUBJECTS ELIGIBLE FOR AUXILIARY NURSING SERVICE

It is notified that subjects of Indian States volunteering for 'general service' are equally eligible with subjects of British India for admission to the Auxiliary Nursing Service. Several hospitals located in Indian States have already been recognized as approved hospitals for Auxiliary Nursing Service training and the Director-General, Indian Medical Service, is prepared to consider the recognition of other well-equipped hospitals in Indian States which are staffed for the training of nurses.

In regard to 'local service' under the Defence Department, a limited number of State subjects may be accepted in the service from the few selected stations where such local nursing assistance is required in military hospitals.

The award of Auxiliary Nursing Service scholarships for the training of Indian State subjects for 'local service' under A.R.P. schemes is being considered.

### THE INDIAN HONOURS LIST

1ST JANUARY, 1942

THE following are the names of medical men, and others associated with medical institutions, in the Indian Honours List of date 1st January, 1942. We offer them our congratulations.

#### *Knighthood*

R. D. Dalal, Esq., C.I.E., Member of the Central Legislative Assembly.

#### *C.I.E.*

Lieutenant-Colonel M. G. Bhandari, I.M.S., Inspector-General of Prisons, Bombay.

Lieutenant-Colonel W. E. R. Dimond, I.M.S., lately officiating Inspector-General of Civil Hospitals, North-West Frontier Province.

Lieutenant-Colonel M. M. Cruickshank, I.M.S., Chief Medical Officer and Civil Surgeon, Delhi, and lately Superintendent, Government General Hospital, Madras.

Lieutenant-Colonel R. Hay, I.M.S., Deputy Director-General, Indian Medical Service.

Lieutenant-Colonel A. H. Harty, I.M.S., Civil Surgeon and Superintendent, B. J. Medical School, and Superintendent, Mental Hospital, Ahmedabad, Bombay.

#### *O.B.E. (Civil Division)*

Major G. S. Gill, I.M.S., Inspector-General of Prisons, Madras.

#### *M.B.E. (Civil Division)*

P. V. Cheriyan, Esq., Surgeon in charge of Ear, Nose and Throat Department, Government General Hospital, Madras.

Captain C. J. Hassett, I.M.S., Agency Surgeon, North Waziristan, and Medical Officer, Tochi Scouts, North-West Frontier Province.

A. X. Pereira, Esq., Resident Medical Officer, Civil Hospital, Karachi, Sind.

Rao Bahadur T. A. P. R. Pillai, Medical Practitioner, Coimbatore, Madras.

J. M. Rakshit, Esq., Chief Medical Officer, Tata Iron and Steel Company, Jamshedpur, Bihar.

Khan Bahadur N. J. Vazifdar, General Secretary, Bombay Provincial Branch, Indian Red Cross Society, Bombay.

#### *Kaisar-i-Hind Gold Medal*

Miss Anna Pollock Martin, Doctor-in-Charge, Mure Memorial Hospital, Nagpur, Central Provinces and Berar.

Miss Louisa Mary Poynder, Medical Practitioner, Simla.

Miss Constance Wilson, Chief Lady Superintendent, Lady Minto's Indian Nursing Association.

#### *Kaisar-i-Hind Silver Medal*

Mrs. Edith Breithaupt, Matron, Lady Reading Hospital, Peshawar, North-West Frontier Province.

Miss Lilavati Sakhawatrai Chablani, Lady Superintendent-in-Charge, Maternity Home, Sukkur Municipality, Sind.

Miss Loal Electa Huffman, Lady Doctor in charge of Butler Memorial Hospital, Baroda.

Miss Vera Constance Victoria Studd, Nursing Superintendent, Zenana Mission Hospital, Tank, North-West Frontier Province.

Sister Doris Miller Timmins, Matron of the Baptist Mission Hospital, Chandraghona (Chittagong Hill Tracts), Bengal.

Mrs. Putlibai Rustomji Vakil, Medical Officer, King Edward Memorial Hospital, Poona, Bombay.

M. V. Apte, Esq., Medical Practitioner, Bagalkot, Bijapur District, Bombay.

The Reverend J. H. W. Schultz, Superintendent, Chandkhuri Leper Home and Hospital, Baitalpur, Drug District, Central Provinces and Berar.

L. M. Sen, Esq., Chief Sanitary Officer, Asansol Mines Board of Health, Bengal.

#### *Kaisar-i-Hind Bronze Medal*

Miss Chandra Keshab, Lady Sub-Assistant Surgeon in Medical charge, Sir Bindon Blood Indian Family Hospital, Roorkee.

Miss Cherry Florence Massey, Lady Sub-Assistant in charge, Peshawar Indian Troops Zenana Hospital.

B. C. Bose, Esq., District Health Officer, Chittagong, Bengal.

#### *Diwan Bahadur*

Rao Bahadur A. L. Mudaliyar, Principal, Medical College, and Superintendent, Government Hospital for Women and Children, Madras.

A. N. Nanda, Esq., Medical Practitioner, London.

#### *Khan Bahadur*

M. A. Allam Sahib Bahadur, Personal Assistant to the Surgeon-General with the Government of Madras.

#### *Rai Bahadur*

Rai Sahib K. P. Mitra, Civil Surgeon, Muzaffarpur, Bihar.

Rai Sahib S. C. Ghosh, Director, Civil Veterinary Department, Assam.

#### *Rao Bahadur*

Rao Sahib Y. P. Vasudevan, District Health Officer, Coimbatore, Madras.

R. K. Mhatre, Esq., Executive Health Officer (Retired), Bombay Municipality, and Assistant Director (Officiating) of Public Health, Bombay.

#### *Shifa-ul-Mulk*

Hakeem M. A. Moid, Member, Board of Indian Medicine, Lucknow, United Provinces.

Hakim S. M. Ahmad, Senior Professor, Government Tibbia School, Patna, Bihar.

#### *Vaidyaratna*

Pandit P. Vaid in charge of the Municipal Ayurvedic Dispensary, Ballimaran, Delhi.

#### *Sardar Sahib*

Y. Singh, Esq., Medical Officer in charge, Victoria Hospital, Darjeeling, Bengal.

Bhai A. S. Chawla, Sub-Assistant Surgeon in charge, Civil Hospital, Daska, Sialkot District, Punjab.

#### *Khan Sahib*

A. Ahmad, Esq., Medical Practitioner, Dacca, Bengal.

K. Ahmad, Esq., Assistant to the Civil Surgeon, Lucknow, United Provinces.

Hakim M. B. Qadri, Unani Physician, Siwan, Saran, Bihar.

A. A. M. Z. Abbasi, Esq., District Medical Officer, Dadu, Sind.

Jemadar B. Ali, I.M.D., Assistant Surgeon, Legation Hospital, Kabul.

#### *Rai Sahib*

N. C. Shome, Esq., Medical Officer in charge, Ursula Horman Hospital, Cawnpore, United Provinces.

B. Gopal, Esq., Assistant Hygiene Publicity Officer, United Provinces.

B. Roy, Esq., Second Medical Officer, Sadar Hospital, Ranchi, Bihar.

#### *Rao Sahib*

B. Misra, Esq., Health Officer, Cuttack Municipality, Orissa.

Subdr.-Major T. V. D. Naidu, I.M.D., Sub-Assistant Surgeon, Port Blair.

#### *O.B.I.*

*To the First Class with the title of 'Sardar Bahadur'*  
Indian Medical Department

Subdr. Kishan Singh Bahadur.

Subdr.-Major and Honorary Lieutenant Rai Sahib Bashi Ram Bahadur.

Subdr.-Major Chajju Singh Bahadur.

Subdr.-Major and Honorary Lieutenant V. K. Nasir-ud-din Bahadur.

Subdr. Raj Singh Bahadur.

*To the Second Class with the title of 'Bahadur'*  
Indian Medical Department

Subdr. (Honorary Subdr.-Major) Amar Nath Puri.  
Subdr.-Major and Honorary Captain Gurdit Singh,

M.B.E.

Subdr. Ram Datta Kumar.

Subdr.-Major and Honorary Lieutenant Aswini Kumar Sarkar.

Subdr. Wadhawa Singh.

Subdr. Ganga Singh.

Subdr. Muhammad Hasan.

Subdr. Basant Singh.

A/Subdr.-Major T. B. Karumbayram.

A/Subdr.-Major Sakharan Sonu Parab.

Subdr. Bhag Singh.

A/Subdr.-Major Hari Singh.

Jemdr. Hanmant Dattatrya Bedekar.

A/Subdr.-Major Bansri Ram Sharma.

Subdr. Abdulmunia Ahmedunia Bukhari.

A/Subdr.-Major Milkha Singh Dhindsa.

Jemdr. Bhai Kartar Singh.

### MEDICAL TECHNICIANS FOR MILITARY HOSPITALS

WITH a view to economising in the use of qualified doctors required by the Army in the present emergency, the Government of India have decided to recruit technicians for employment on routine medical duties in military hospitals.

These men will be employed as compounders, radiographers, and laboratory assistants and will be enrolled as Warrant Officers, Class II, in the Indian Medical Department. They will relieve a large number of doctors who will be utilized in other spheres requiring expert knowledge.

The men to be recruited for this service will be required to have passed the matriculation or an equivalent examination of a recognized Indian university. Preference will be given to those possessing previous training and experience in their special subjects.

Men already in Government service who wish to volunteer will be eligible for this service. They will be given an extra 25 per cent of their pay as compensatory allowance while serving in India and 50 per cent if called upon to serve overseas.

### GERMAN INFANTILE MORTALITY

THE death rate of German babies last year was still much higher than the infant mortality rate in England, comparing the figures for 126 English large towns with German towns having a population of over 100,000.

The latter statistics, from the Reich's *Journal of Public Health*, which have now become available, give an infantile mortality rate during 1940 of 63 per 1,000 as against the English rate of 51. The German rate is the highest for the last four years, for each of which it has been at least 10 per 1,000 higher than the English rate. In no one year since the Nazis bluffed their way to power has the number of the 'Herrenvolk's' surviving infants approached the English total.

## Public Health Section

### HEALTH LEAGUES IN INDIAN VILLAGES

THE Public Health Commissioner's annual report for 1940 draws attention to the increasing interest that Provincial Governments have been taking in the welfare of the rural population. It is pointed out that, in a number of provinces, studies in the organization of a rural health service have been in progress through the formation of health units, that the question of improving and extending water supplies in the rural areas has received attention and that the provision of a cheap but satisfactory system of night-soil disposal has also been under investigation. A health unit is an organization set up in an area with a population of approximately 40,000 for the purpose of studying the methods of developing a rural health service. The staff usually consists of a medical officer of health, an assistant medical officer, preferably a woman, four sanitary inspectors, four health visitors, eight midwives, one clerk and the necessary menials. An encouraging feature of the health unit system has been the development of health leagues in villages. Health units were working during 1940 in the provinces of Madras, Bombay, Delhi, Bengal and the United Provinces. The Rockefeller Foundation has made substantial grants to these health units and has also helped their working with the technical advice of different members of its staff resident in India.

#### *Work of health leagues*

Dr. W. P. Jacobs, Regional Director in India and Ceylon of the International Health Division of the Rockefeller Foundation, states that the entire village population constitutes the league membership, and at meetings any member of the village community is free to offer suggestions or to discuss proposals.

The usual procedure is to form a small committee consisting of a chairman, a secretary and three or more members of the village. This committee meets monthly and records its deliberations in a minute book. A member of the health unit staff attends the committee by invitation and gives the committee the benefit of his technical knowledge. As a result, at one of the early gatherings a programme is prepared containing various items of work to be attempted and the order in which they are to be taken up. These details include clean-up days by sweeping and by removing the cattle to the borders of the village, vaccination against smallpox and other diseases, putting ventilators and windows in homes, digging bore-hole soakage pits and bore-hole latrines, collecting vital statistics, and attending to other similar village needs.

#### *Famine relief*

In the past, famine relief consisted mainly of providing work for the people of the affected areas and of paying them wages with which to purchase food. The physiological aspects of nutrition were not recognized and no provision was made to ensure that, under the conditions of physical strain that accompany famine, the nutrition of the people was kept at a sufficiently high level to ward off disease.

The advantage of active co-operation between the health authorities and the officials carrying out famine relief measures has been fully demonstrated during the past few years in the famine-stricken areas of the Hissar district in the Punjab and in Ajmer-Merwara. In Hissar all preventive and curative work was carried out in a co-ordinated manner and the measures taken included: (1) reduction of the task of workers to the extent of 50 per cent, (2) the location of new works in such places as would reduce the distance that the labourers had to walk, (3) the division of the whole area into 50 health circles, each consisting of villages within a radius of five miles, and the organization of special treatment centres with a medical officer in charge of each circle, and (4) distribution of germinated grain and *amla* (Indian gooseberry) to make up food deficiencies.

The value of the measures can be assessed from the fact that, within a few weeks of the administration of germinated grain and *amla*, conditions due to food deficiencies, such as scurvy and night blindness, altogether disappeared from the famine-stricken population. The Director of Public Health, Punjab, points out that the cost of these measures was only one-tenth of an anna per head of the population per week.

In Ajmer-Merwara, the experience gained in Hissar was utilized and germinated grain was distributed among the population before deficiency diseases made their appearance. It is stated that no case of scurvy occurred among the people and that the growth and the general health of the children did not materially suffer.

#### *Services of labourers*

The Public Health Commissioner makes some interesting remarks regarding the utilization of the services of the labour population in famine areas for work of such a nature as will prove to be of permanent value to the village community. He says, 'such measures as improvement of water supply, development of rural communications and planting of trees may, with advantage, be carried out. In a malaria-stricken area much of the earth-work associated

with anti-mosquito measures can be carried out. The sanitation of the village site is another important direction in which the services of the people can be usefully employed. By directing the energies of the people into such useful channels it may be expected that the improvements effected will leave a lasting impression on their minds and that the development of co-operative effort among the people for the betterment of their own health will be promoted'.

#### *Health of school children*

The children of to-day are the citizens of to-morrow. The medical care of school children includes their periodical examination by competent doctors, the treatment of the defects discovered during such examinations, provision for under-nourished children of such food as may be necessary to raise them to an average standard of health and the inculcation of hygienic habits through example and precept by their teachers and the school medical staff.

#### *School medical service*

The school medical service has not been organized in this country on the same generous lines as in more progressive countries in the West. The Public Health Commissioner's report draws attention to what is being done in New Delhi to improve the health of school children.

In New Delhi the school medical service was in its fourth year of existence in 1940. The Chief Health Officer, Delhi Province, points out that during the year there was an appreciable diminution in the percentage of children with defects requiring treatment and that there was reason to believe that the medical care devoted to these children during the previous three years has begun to exert a beneficial influence on the general health of the children.

The principal defects noted were malnutrition, dental trouble and defective vision. The extent of dental trouble prevalent among school children may be judged from the fact that during the year the school dentist carried out 474 extractions, 406 fillings, 93 nerve treatments and 74 cleanings of tartar deposits. In addition, treatment was given for 39 cases of gingivitis and 17 cases of calcium deficiency. The numbers of boys and girls discovered during the medical examination to have errors of refraction were 259 and 244 respectively.

During the year, the Central Advisory Board of Health considered the dual question of the teaching of hygiene in schools and of the medical inspection of school children. The question is now being dealt with by a joint committee of the Central Advisory Board of Health and the Central Advisory Board of Education.

### THE ROLE OF PROTOZOA IN THE ACTIVATED SLUDGE PROCESS

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THE efficiency of the activated sludge process depends on the formation of the active clot which forms the nucleus of sludge formation and thus facilitates the removal of solid putrescible organic matter. The mechanism of the formation of this clot has been studied by a number of workers commencing with Fowler and his associates in 1913. In fact work on flocculation of colloidal matter in sewage began some years prior to the activated sludge researches which date from the work of Fowler and Mumford on the bacterial clarification of sewage employing a new iron bacterium, 'M.'. Quite recently Heukelekian (1941) has reviewed the present state of our knowledge of mechanical flocculation and bioflocculation of sewage, and concluded that the flocculation is brought about both by physical and biological agencies working either independently or simultaneously. Mechanical flocculation plays a more important part during short periods; as the period is increased, bioflocculation plays an increasingly important rôle. It would appear from his account that, on the biological side, the protozoa are not recognized as an important factor in the clarification and flocculation of sewage.

Fowler's observations (1916, 1922) suggested that the activated sludge process 'can be referred entirely to bacterial activity', the ideal being to produce a mass of active bacteria of the desired type, which would then function under the best possible conditions. Arden and Lockett (1914) observed that the protozoan content of the tank 'rather indicate a particular condition of the activated sludge that play an important part in the changes effected'. Harris *et al.* (1920) adduced evidence that the presence or absence of protozoa neither increases nor detracts from the efficiency of fully matured activated sludge, and that the significance of their presence and the value attached to the identification of the prevailing forms lie rather in the information thereby afforded as to the condition of the sludge, and the timely warning given of the onset of unhealthy and undesirable developments. Fairbrother and Renshaw (1922), however, considered the presence of protozoa harmful to the process of purification, and even recommended that they might be killed off by the selective action of the oxazine group of dyes. The earlier evidence would thus suggest that floc production in the activated sludge tank is predominantly due to a nucleus of aerobic bacteria which multiply under the conditions of the tank and, at the same time, act as a kind of sieve for removing the suspended organic matter.

It was however recognized that the 'non-bacterial population' together with the

flocculated colloids account for the high nitrogen content of activated sludge (Ardern, 1920). The experiments carried out by Richards and Sawyer (1922) indicated that protozoa, in the numbers which were actively found in Harpenden activated sludge, might easily contain at least half the extra nitrogen beyond that found in simple sedimented sewage solids. The latter workers further observed that the increase in bacterial numbers, consequent on suppression of the protozoa by the partial sterilization, produced no improvement in purification of sewage and that both carbon and nitrogen oxidations were seriously retarded. Swaminathan (1929) confirmed the latter observation that, although inhibition of the protozoa resulted in an increase in the bacterial population, nitrification did not take place more rapidly.

Buswell and Long (1920-1922) described activated sludge flocs as composed of a synthetic gelatinous matrix, in which filamentous and unicellular bacteria are embedded and on which various protozoa and some metazoa crawl and feed, and contended that the purification is accomplished by ingestion and assimilation of the organic matter in the sewage by organisms and its re-synthesis by them into the living material of the floc, though no proof of this statement was given. Cramer (1931) concluded from his experiments that a vigorous and healthy protozoan life should be maintained in the sludge, and suggested that a daily microscopic examination of sludge would soon be recognized as the most effective means of controlling conditions in the activated sludge process. At the same time the protozoa help to synthesize the organic matter which would otherwise remain in a colloidal non-stable state, then when they reach a certain stage of development die and disintegrate and thus afford further food for the bacteria. More recently Butterfield *et al.* (1937) have reported that a certain amount of clotting could be obtained with some of the bacteria present in the sewage and, although they have emphasized the primary importance of bacteria in the activated sludge process of purification, they have admitted that there may be several other organisms which are equally or possibly even more potent in forming the sludge. Viehl (1937) found that the oxidation of dissolved organic matter is carried on by bacteria alone but the flocculation and adsorption of colloids are dependent on the presence of protozoa in general and ciliates in particular.

Independent of the above studies, there has been growing a considerable volume of literature on the occurrence and distribution of protozoa in the activated sludge tank. Even the earliest workers with activated sludge called attention to the great number of protozoa that were always present (Ardern and Lockett, 1914). The presence especially of certain forms of protozoa in a vigorous state of activity has been found to be a characteristic of 'healthy' sludge containing a high percentage of nitrogen.

Conversely, it has been observed that as the protozoa either diminish in numbers or become encysted for some reason or other, the whole process of purification is adversely affected.

Although the foregoing observations suggest that the protozoa probably play a rôle in the process of purification, yet very little work has been done with a view to elucidating their direct part in the process. This may be largely traced to the general impression that the protozoa destroy bacteria and consequently in some way interfere with the normal functioning of the important aerobic bacteria. How far this actually occurs is still not proved. In fact, Nasir (1923) and Cutler and Bal (1926) found that the presence of a protozoon actually increased the amount of nitrogen fixed by *Azotobacter chroococcum*, although their numbers were decreased.

Recently the present author (1938) was placed in control of the putting into operation of the new activated sludge installation at Cossipore, Calcutta. This is perhaps the largest plant in India on the 'complete' or pioneer activated sludge process, i.e., without preliminary settlement of sludge. He then observed that building up of sludge in the aeration tanks proceeded simultaneously with the appearance and development of certain forms of protozoa, especially the species of *Vorticella*. Further comparative studies (Pillai, 1941) carried out with cultures of this and other species of protozoa by inoculating them in different ways into raw and sterilized sewage and by bubbling air through the suspensions clearly showed that they are, as a group, much more efficient in floc formation than any of the bacteria tried singly or in combination. Among the protozoa studied, the species of vorticellidæ and epistylidæ gave much the best results. It was observed that the sewage after a few hours' treatment with these forms of protozoa, when allowed to settle, yielded a supernatant which showed (a) considerable decrease in suspended matter and colloids, (b) considerable decrease in the free and saline ammonia as also in albuminoid ammonia, and (c) rapid nitrification. Nitrate formation was found to take place much earlier. It was also observed that the resultant sludge contained more nitrogen than that from the bacterial series.

The protozoa have therefore important functions to perform in activated sludge. Both by their physical structure and through the formation of a slimy mass, the protozoal colonies appear to behave like minute pieces of sponge. These flocculi, offering a very large surface area for contact, absorb the suspended organic matter and ammonia of the sewage during the process of aeration which provides the necessary agitation, and thus promotes the conditions necessary for nitrification. The increased nitrogen content of the sludge from the protozoa series may be due to the protein of the cells of protozoa, which holds up a considerable part of



the nitrogen originally gained from the sewage. Thus the rôle of protozoa in the activated sludge process is at least threefold: they bring about efficient flocculation, rapid nitrification, and considerable nitrogen conservation.

The author thanks Professor V. Subrahmanyan for the great interest he has taken in the work and for his encouragement. His thanks are also due to Dr. Gilbert J. Fowler for having given him an opportunity to study the conditions in a new activated sludge plant.

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## Current Topics

### Chemotherapy in Acute Otitis Media

(From the *British Medical Journal*, Vol. II, 5th July, 1941, p. 20)

HARVEY CUSHING once pointed out that progress in medicine occurs mostly by fission, and that special departments and groups, once they are strong enough to be independent, seldom fuse either with one another or with the parent body. He revealed a proposal for the creation at Johns Hopkins University, on the resignation of Osler, of a *super-professorship* of medicine to keep all the departments in contact and in proper relationship with one another. The scheme never matured because W. H. Welch, who was asked to undertake the task, refused; but it is not difficult to see what influence the holder of such a position might exercise. One matter that would certainly occupy his attention to-day would be the control of acute bacterial infections by chemotherapy. Every clinical department, both general and special, has turned eagerly to the new resources. Enthusiasm and sometimes lack of judgment have been manifested, so that the abuse of chemotherapy has become as important a subject for inquiry as its use. A speaker in a recent debate named the quantity of the new drugs which had been dispensed in one year in a large hospital in London, and the figure was so large that it is impossible to avoid the conclusion that a respectable fraction must have been misapplied. This is probably the state of affairs in many other hospitals. The early and most spectacular successes with chemotherapy were in cases of septicæmia, mostly obstetrical in origin; but such cases are sometimes otogenic, and aural surgeons soon found that not only septicæmia but also meningitis could be controlled, and that recovery could become commonplace in cases which a few years ago would certainly have been fatal. Recovery, however, if no longer a miracle, is still not the end of every case. Why should there be failures? How and to what extent should chemotherapy be used in those early infections where complications have not yet arisen and the trouble is likely to be self-limiting?

The answer to the first question is twofold. It is necessary to be certain that the infecting organism, both in the primary focus and in the area to which the complication has extended, is one which may be expected to yield to the treatment. Clinical examination, however careful and frequent, is nowadays not enough.

Bacteriological examination is essential so that the appropriate drug, if there be one available, may be administered. Generally sulphanilamide is chosen, but in a pneumococcal infection it may be necessary to change to sulphapyridine or sulphathiazole. Secondly, the treatment cannot succeed in the presence of a collection of undrained pus or if there is an infected thrombus anywhere in the area concerned. It is no use demanding the impossible of these drugs, and to employ them in such circumstances only brings discredit on a potent remedy; for either the patient will die unrelieved or there will be a temporary but only apparent clinical improvement which masks the real state of affairs. In the latter case the complication will ultimately prove fatal, even if it seems to disappear, as in the case of meningitis, for it will be fed afresh from the primary focus of suppuration if this is not eliminated. The treatment required may vary from a simple paracentesis of the tympanum to an extensive mastoid operation. If there is a venous thrombosis the clot need not, in theory, be disturbed so long as it is aseptic; but how often this occurs may be guessed from the usual clinical history of such cases. In practice it should be removed until there is free bleeding from each end of the opened sinus. If it extends downwards out of reach to the jugular bulb there should be no hesitation in tying and dividing the jugular vein in the neck, so that the bulb can drain when the ligature is removed from the upper end of the vein. It seems remarkable—even taking for granted the potent effect of the appropriate drug on each organism—that in purulent streptococcal or pneumococcal meningitis so many recoveries ensue, for the ease with which a collection of pus may become entangled in the meshes of the arachnoid must be a severe handicap upon the action of the drug. It may be, therefore, that a basal meningitis, on account of the size of the cisterns, is more prone to resolution than a meningo-cortical extension, which would easily become encysted and localized into an abscess. For this reason a very high percentage of recoveries from meningitis can be expected only when the treatment is administered at an early stage.

Chemotherapy has proved its worth under desperate conditions. The next question is, how and to what extent it should be used in early infections that are likely to be self-limiting and which might recover spontaneously or with simple, old-fashioned treatment? Once an acute infection of the middle ear has been



initiated it is impossible to predict what its course may be. It is therefore wholly reasonable to adopt a treatment that may shorten its duration and, by promoting early resolution of the inflammation, give protection against complications. That chemotherapy can do this is not merely a general clinical impression; the figures of Horan and French give satisfactory proof. In a series of 607 cases from 1934 to 1937 there were 138, or 22.7 per cent, needing the mastoid operation. In 621 cases treated by chemotherapy from 1937 to 1939 only 21, or 3.4 per cent, required operation; there were no deaths in the second series. Wesley Bowers has produced similar evidence. In a series of 793 cases, 396 were treated by chemotherapy. He found that both the duration of the discharge and the proportion of patients needing mastoid operation were reduced in this way by 50 per cent.

The statistics of Horan and French present two convincing features. The numbers of the control series and the experimental series are nearly the same, and the clinical material is of a homogeneous character, being drawn from the personnel of the Royal Navy. Not only is the number of mastoid operations materially reduced, but the absence of any fatality is strong evidence of protection against complications. There is, therefore, justification from the evidence (supported by the observation of Wesley Bowers) for administering either sulphanilamide or sulphapyridine in acute otitis media. But this is not to be done in a casual manner, for although the administration is an exceedingly simple matter it is not without some risk. Here again it is necessary to know the nature of the infecting organism if it is to be made certain that an appropriate drug is available for administration. It is no excuse to plead that because the tympanic membrane has neither ruptured nor been incised there is no discharge to examine. The infection comes from the nasopharynx, and material taken from there will give the bacteriological diagnosis. In any case discharge collected from the meatus is liable to be contaminated from the skin.

In all statistics the majority of infections are shown to be streptococcal, though the pneumococcus is nevertheless frequently found. T. B. Layton has divided the infections of the middle ear into the nasopharyngeal and the cutaneous—the former travelling by the Eustachian tube and the latter reaching the tympanum from the skin of the meatus through a perforation. This assumes that the primary infections are streptococcal and pneumococcal, while the *Staphylococcus aureus* is a secondary infection from the meatus; along with it go a number of other organisms, including *Staphylococcus albus*, *B. coli*, *B. proteus*, and *B. pyocyaneus*. The latter are no doubt secondary invaders. But the question which is difficult to settle is whether the *Staphylococcus aureus* attacks the middle ear as a primary nasopharyngeal infection. E. P. Fowler of Columbia University, in a series of 2,775 cases in the years 1933 to 1939, found pure cultures of staphylococcus in 36.7 per cent. This is far higher than most authors report, and is a justification in taking material from the meatus. That the *Staphylococcus aureus* is occasionally the primary organism (but much more rarely than Fowler suggests), and that it easily overgrows and masks the primary organism in cultures from the meatus. Certainly it is remarkable how constantly the *Streptococcus pyogenes* is found by the bacteriologist when the culture is made at an operation from pus in the mastoid process or—what is the only absolutely satisfactory method—from chips of bone. This explains the frequent success of sulphanilamide given empirically, though it affords no justification for neglecting bacteriological examination or for not taking care to avoid contamination in collecting material for the laboratory.

The general risks attaching to the administration of these drugs—such as gastric intolerance, leucopenia, and occasionally agranulocytosis—are well known and concern only the exceptional patient. It is perhaps not practicable to obtain blood counts in every case, but if the clinical course is not satisfactory and suggests unusual sensitiveness, which is naturally beyond control, the blood examination should certainly not be omitted.

There does, however, appear to be a decided though easily controlled risk arising from insufficient dosage. This insufficiency may come about either by administration in too small quantity (which for an adult should be 2 grammes as an initial dose—continued at the rate of 1 gramme every four hours, taking the age and especially the weight of the patient into consideration), or by administration over too short a period (which should extend to two or three days after all clinical signs have disappeared). If the administration is stopped too soon there may be either a relapse or a subsidence of symptoms, masking incomplete resolution and leading to complication later. Repeated examination of the ear is essential; if the patient is in pain or the tympanum is seen to fill with fluid under tension, paracentesis should not be withheld in the hope that the process will resolve without spontaneous perforation of the membrane. The neglect of paracentesis at the right time may be a factor causing either incomplete resolution and an adhesive otitis with subsequent deafness, or the need for a mastoid operation. Unless these precautions are observed and the patient is kept in bed, it is better to employ the ordinary methods of treatment only. Fowler recommends that treatment by chemotherapy should begin a week or ten days after onset if the patient does not seem to be getting on well without it. It seems reasonable, however, to begin the treatment as early in the course of the illness as possible under the conditions already mentioned. If the best results are to be obtained from the drugs used in chemotherapy their limitations must be recognized and they are not to be regarded as a panacea for all acute infections. The drugs are so powerful that the early results seemed to border on the miraculous, but this is no excuse for using them in a casual way: their very potency demands that they be used in the most efficient manner available.

### Sulphanilylguanidine in Acute Bacillary Dysentery

(From *International Medical Digest*, Vol. XXXIX, July 1941, p. 57)

THE amazing successes which have been achieved in the treatment of the various disease entities by chemotherapy with the 'sulpha' drugs are increasing so rapidly that it may well be said that progress in the fight against disease has been greater in the past few years than it has been for several decades. In grim contrast to the wanton and ruthless destruction of human life overseas, these drugs have long since fulfilled Paul Ehrlich's dream of saving life by chemotherapy.

The latest of these life-saving drugs is sulphanilylguanidine, which was first studied by Marshall and his associates. One characteristic noted about this chemical was that, while it is freely soluble in water, it is absorbed poorly in the gastro-intestinal tract. This suggested the possibility of building up a rather high concentration of the drug in the intestinal tract with a relatively low concentration in the blood. For this reason, Marshall and his associates undertook its use in the treatment of acute bacillary dysentery in young infants and children. They treated successive patients with good results, but did not make any controlled study. As a consequence, Dr. George M. Lyon, of Huntington, West Virginia, who has done considerable research in pediatrics, began a study at the suggestion of Commander Stephenson, who is in charge of the Division of Preventive Medicine, of the Bureau of Medicine and Surgery of the United States Navy. Dr. Lyon engaged in this study for the dual purpose of determining the value of the drug in pediatric practice and ascertaining its effect on bacillary dysentery in general. The Navy Department requested him to make this study because of his being a Commander in the Reserve Corps of the Navy. The sulphanilylguanidine was furnished by Dr. E. K. Marshall, Jr., of the Department of Pharmacology and Therapeutics of Johns Hopkins School of Medicine and the Calco Chemical Company.

Dr. Lyon attempted to evaluate the effect of the drug in the treatment of acute bacillary dysentery by comparing one group of patients treated with the drug with another group of patients who did not receive the drug. He selected alternate patients for treatment with the drug; there were 23 patients in each group.

Inasmuch as bacillary dysentery occurs endemically in the rural and mountainous mining areas of West Virginia and in the Tri-State section of West Virginia, Kentucky, and Ohio, the area afforded a good opportunity for studying the effects of sulphanilylguanidine in acute bacillary dysentery. It has been reliably established that the Flexner bacillus has been responsible for fully 80 per cent of the cases of bloody diarrhoea occurring in this area, and while there has been a decrease in frequency, this condition continues to be a common and important cause of morbidity. In the past decade there has been a remarkable decrease observed in cases among residents of urban districts, and at present, the majority of cases originate among those adjoining rural areas, where community sanitation has been most neglected. Where sanitation has been better developed, there has been a notable decrease in the incidence of the disease.

Dr. Lyon secured the co-operation of 24 physicians throughout the area, so that it was possible to include in his study practically all of the dysentery patients admitted to eight hospitals scattered throughout an area which extended for more than 75 miles to the north and west of Huntington, West Virginia, and more than 125 miles south and east of the same point. The study was initiated in the latter half of September, and completed in December 1940.

All studies and recordings were made in accordance with a prearranged plan. Systematic observations and recordings were made on all patients included in the study. Not all patients were in one locality nor were they all hospitalized, but they were supervised in such a manner that standard procedures were followed and appropriately reliable observations obtained.

In selecting cases for study, an attempt was made to include only those patients presenting a clinical picture which could be classified as 'moderately severe' or 'severe'. For this reason, it was required that each patient have a 'bloody diarrhoea' with blood, pus, and mucus in the stools; have a temperature of not less than 102°F.; and be admitted to observation before the end of the first week of the diarrhoea. The majority of the patients were infants or young children. In three instances, it was either impossible to exclude the patient without upsetting the sequence of the series or desirable to include the patient, because of the peculiarly significant features of the clinical picture presented. Such irregular inclusions were made in the group receiving the drug and tended to make the test more rigid rather than to relax it in favour of the drug. In no instance did they distort the significant aspects of the study.

*Alternate selection.*—Patients were selected alternately for the treatment group and for the control group on the basis of the time they were first admitted to observation. Many others with bloody diarrhoea had to be rejected because they failed to meet the rather rigid criteria set for selection. Generally this was because they presented clinically a too mild form of the disease or were seen after the first week of diarrhoea at a time when one might expect that the natural recession of the clinical activity would soon follow. To include in the treated group patients of the latter type would obviously distort the validity of the conclusions. It is of interest to note that many of the patients who were not included in the study group were treated with the drug and the results were distinctly in keeping with those of the study group.

*Treatment.*—The general treatment given the patients of both groups consisted of the usual supportive general measures with insistence on maintaining a good fluid balance and, when indicated, serum transfusions, whole blood transfusions, intravenous glucose, etc. Special attention was paid to the vitamin intake. Laxatives were not permitted. Opiates or phenobarbital or a

combination of opiates and phenobarbital was given for relief of tenesmus, pain, and restlessness. Breast-fed infants were permitted to continue on the breast. Whole cultured lactic acid milk was given to the majority of the patients. In general, very bland, high protein, low fat diets were employed while much of the carbohydrate was given in the form of glucose. In all but three instances temperatures were taken by rectum. Cytologic examination of the blood was made at one time or another on roughly one half of both groups. In several of the patients who received the drug, blood level studies were made, the standard employed being the anhydrous sulphanilylguanidine supplied by Marshall. In infants and children, as a rule 0.04 c.c. of blood was drawn, precipitated in a 1:200 dilution and the determination completed as described by Marshall. Follow-up studies of the urine and blood were made in an attempt to detect any injurious effects which might develop as a result of the treatment. Stool cultures were done in approximately one half of the cases. Of the patients receiving the drug, one-third had stool cultures positive for the Flexner bacillus. A reliable diagnostic test, generally neglected by physicians in general practice, was employed in many cases where stool cultures could not be made. In these, the purulent material of the stool was subjected to microscopic examination. In all such instances, the characteristic polymorphonuclear cells were found.

In the patients receiving sulphanilylguanidine, the procedure was very well standardized as to dosage, but there was an occasional irregularity in the time at which the drug was discontinued. These few irregularities did not distort the significant features of the study. The drug was given in accordance with instructions proposed by Marshall. The initial dosage was 0.1 gm. per kg. of body-weight and the maintenance dose was 0.05 gm. per kg. of body-weight every four hours until the stools were five or less per 24 hours, and thereafter 0.05 gm. per kg. every eight hours for 48 to 72 hours. The drug was a fine white powder, not very soluble in water, practically tasteless, and not at all unpleasant to take. It was given in a suspension of water or milk. One should be careful to see that it is well washed out of the receptacle in which it is administered. In many instances, it was given by oral gavage in a suspension of lactic acid milk or water. Surprisingly little difficulty was encountered in giving it and it was singularly free from immediate or late toxic effects.

*Treatment of patients not receiving drug.*—In the patients of the control series, every benefit of modern pediatric treatment was provided, except that no sulphanilylguanidine, sulphathiazole, etc., were permitted during the first two weeks of observation, and no anti-dysenteric serums or vaccines were employed.

The patients included in both groups of the study presented a clinical picture which is encountered with significant frequency by the physicians of the area in which the study was conducted. All of the physicians participating in the study had previously had extensive experience with such cases. They were peculiarly well fitted, not only to supervise the general medical care of these patients, but to express trustworthy opinions as to the efficacy of the drug in this disease.

In attempting to evaluate a therapeutic procedure in acute bacillary dysentery, one must be mindful of the vagaries of the clinical picture of the disease. If one takes the presence or absence of fever as the index of activity of the infection, one cannot be certain of the exact time of onset, because frequently temperatures are not taken until the physician is consulted. Once the patient is under observation, the temperature may, with certain reservations, be taken as an index of the activity of the infection. This has its practical limitations in that most patients continue to suffer from bloody or purulent diarrhoea for some time after the fever subsides, frequently for as long as two weeks or more after the temperature has returned to an essentially normal level.

For purposes of objective comparison, one obtains from the clinical history a more reliable 'onset' if one

takes the appearance of the first loose stools as the time of onset. In most instances this will be the first day of illness, but it is not at all infrequent for vomiting and fever or even convulsions to precede the diarrhoeal stools by 24 to 72 hours.

Onset of illness in this study has been considered as onset of diarrhoea, although in each case data have been sought for and, insofar as possible, recorded as to probable onset of fever and other evidences of illness such as convulsions, chills, vomiting, etc.

In determining the course of the clinical activity and its recession, three objective manifestations of the disease have been considered, none of which is by itself a completely satisfactory yardstick. One almost never observed the clear-cut end point in the matter of the cessation of diarrhoeal stools in the control group that was observed almost regularly in the patients successfully treated with the drug. In the control group, the change from abnormal stool to normal stool was nearly a three to four-day affair, just as it has usually been observed in other patients in the past in this disease.

The temperature curve was observed and when it remained below 38°C. (100.4°F.) per rectum, the temperature was recorded as normal; days of fever were charted on the basis of whether the temperature of a patient did or did not exceed this level.

The number of stools in 24 hours was also considered as a possible index of the clinical activity. When stools were four or less in 24 hours, this was noted and comparisons were made on the basis of the number of days required for the stools to return to this arbitrary frequency.

Neither the temperature curve nor the number of stools in 24 hours can be expected to tell the whole story, so a term similar to that employed by the workers in the Harriet Lane Home has been used. By the use of the expression 'diarrhoea checked' it is meant that the stools were pasty or formed and contained no gross blood or pus and had little, if any, mucus. Generally it meant as well that there were not more than four such stools in 24 hours. Obviously, such a stool is a relatively normal stool. In the patients of the control series, changes in the stools took place in the same manner as in the past. It is a matter of common observation that during the stage when the stools are just beginning to return to normal, there may be one relatively normal stool in the morning with no blood or pus, and subsequently during the day, one or more small ones will be passed which contain pus or perhaps a little blood. The transition from abnormal to normal may, therefore, extend over as much as three to seven days or more, and yet the clinical progress of the patient may be distinctly satisfactory, with perhaps even some ambulatory activity being permitted.

As the study progressed, it was found that for comparative purposes the onset of the disease could quite satisfactorily be taken as the date of onset of the diarrhoea. Fortunately, in the majority of the patients who received the drug, in marked contrast to those of the control group, the fall in temperature was generally accompanied by, or within 24 to 48 hours followed by, a change in the number and the character of the stools. In almost every instance in which therapeutic benefit was observed, the rather intangible and not at all readily measured general clinical trend of the patient presented a definitely significant aspect, one which in the end is quite as convincing as the apparently better measured indexes, e.g., the 'diarrhoeal stool', or freedom from fever.

*Conduct of study.*—Patients receiving the drug were treated within 24 hours after admission. Records were kept as to the temperature curve, the changes in frequency and character of the stools, and the changes in the general clinical trend. The drug was administered so as to provide a dosage of 0.1 gm. per kg. of body-weight for the initial dose and 0.05 gm. per kg. every four hours for the maintenance dose. When the stools became less than five in 24 hours, 0.05 gm. per kg. was given every eight hours for 48 to 72 hours thereafter. The drug was given suspended in water or milk. In a few instances, it was given for a longer

period, largely as an experimental affair, although to some degree because of fear of a relapse. Later it was found that this was, in fact, a rare occurrence and the original plan for discontinuing the drug was adhered to. In some instances, which were beyond control, the drug was omitted before the desired time.

In the general observations which were made, the most outstanding feature was the almost unbelievable improvement in the clinical picture of the patient, which was observed within 24 to 48 hours after the administration of the drug.

While this was not a matter of universal occurrence, the fact that it occurred so dramatically in the majority of patients so treated remains a most significant fact. Its effect can truly be compared to that of sulphanilamide in infections due to some streptococci and to that of sulphapyridine and sulphathiazole in pneumonia due to pneumococci.

In many instances the result was comparable to that which takes place when specific antitoxin is employed in some of the other infections. This dramatic decrease in the intensity of the toxic manifestations of the disease, the striking improvement in the clinical condition of most of the patients, and the rapidity with which this took place were truly remarkable. This can be fully appreciated only by those accustomed to observing cases of bacillary dysentery of such a degree of severity as that which characterized this group of patients. The tendency for the diarrhoea and the indigestion of these patients to drag out over two, three or more weeks, under any form of treatment previously at our disposal, is well known to all who have had experience therewith.

The diarrhoea was considered to be 'checked' when the stools were four or less in number daily, were pasty or formed, and were without gross blood or pus.

In the patients receiving this drug, the transition from abnormal to normal stools was generally rapid. In patients not receiving sulphanilylguanidine, the transition was not so quickly accomplished and the end point was not so clear-cut. In the majority of the controls, the stools continued to be occasionally softer than desirable; they occasionally contained some mucus and, at times, even a little blood or pus.

The tendency for the temperature to return to normal more quickly in those receiving the drug was also an extraordinary feature, and a normal temperature was reached almost as promptly as the stools returned to normal.

In those instances where blood counts were studied and where leucocytosis was observed, the leucocyte count tended to return to a more normal level within 24 to 48 hours after beginning the treatment with the drug. Follow-up studies indicated that it was certain that this was not due to the effect of the drug on the leucocytes. No agranulocytic phenomenon was definitely observed although for a time it was suspected in two cases.

Lyon's conclusion is that there is every reason to believe that sulphanilylguanidine is most efficacious in the first three or four days after onset of fever or diarrhoea and that the percentage of failures may be higher when given later in the illness.

Observations at hand lead to the assumption that sulphanilylguanidine is an effective agent for the treatment of acute bacillary dysentery. While in the dosages recommended, it appears to be a safe therapeutic agent, it should be used with conservatism and conclusions drawn guardedly. Toxic effects may be observed, but only in those patients with concomitant infections outside the intestinal tract and not, indeed, with certainty then. Its use is attended with fewer toxic side effects than that of the related compounds.

Like other pioneers, Lyon suggests that the final place of this new 'sulpha' drug in the field of chemotherapy can be further established only by appropriate use and study. Nevertheless, the study which he has made is sufficient to justify the belief that another milestone has been reached in the pediatrician's conquest of diarrhoea in young children. The consistent decline in so-called summer diarrhoea, since the turn of the century, has been most gratifying. The decline began

when Henry L. Coit first made his fight for pure milk at the beginning of the century. The next epoch-making step which further reduced diarrhoeas was the curd studies of Brennemann, who demonstrated conclusively that all milk used in infant feeding should be boiled. Added to this, of course, has been a more perfect public health programme, which has brought about community sanitation, a more rational knowledge concerning the nutritional requirements of infants and young children, and, in general, the more careful supervision of these age groups, which has come about largely as a result of the development of pediatrics into an important branch of medicine.

In conclusion, we may repeat what we said of sulphadiazine. This study of the effect of sulphanilguanidine in acute bacillary dysentery in children is just one more reason why Paul Ehrlich's dream of the advantages of chemotherapy is being realized far more effectively than he had reason to believe it would.

### The Influence of Expectorants and Gases

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and

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(Abstracted from the *Journal of the American Medical Association*, Vol. CXVII, 30th August, 1941, p. 677)

A CERTAIN rationalization of therapeutic procedures used in the management of broncho-pulmonary suppurations and obstructions may be suggested to coincide with the bronchoscopic observations and a study of the effect of therapeutic agents on sputum.

In general, it may be stated that factors responsible for liquefying sputum within the bronchi, thus aiding in its evacuation, consist of those agents which will increase the hyperæmia of the mucosa, as well as those which will increase the rate and depth of respiration.

The action of the expectorant drugs is almost uniformly favourable in liquefying a portion of the sputum which lies in the first and second division bronchi but rarely affects the dependent viscid secretions in the peripheral bronchi.

The actions of gas inhalations are quite specific, and they grossly influence the physical and chemical qualities of both the expectorated and the bronchoscopically obtainable sputum as well as the character of the bronchial mucosa. Steam inhalation, or the inhalation of a high humidity atmosphere, results in the liquefaction of sputum. Carbon dioxide has an action quite similar to that of steam, but to a greater degree. And, in addition, it increases the resorbing power of the bronchial mucosa; consequently it may be considered an extremely efficient expectorant.

Oxygen acts very specifically as an antiexpectorant and therefore its use alone is contra-indicated in obstructive lesions whose obstruction is in part, at least,

due to copious, viscid secretions. This deleterious effect may be neutralized partially or wholly through the addition of steam and 5 to 10 per cent carbon dioxide. In this manner not only the tremendous value of oxygen in alleviating the symptoms of respiratory embarrassment or even respiratory decompensation is retained, but also necessary aid in removing the obstruction is administered.

The use of codeine and atropine at regular intervals over long periods of time is contra-indicated in broncho-pulmonary suppuration producing obstructive symptoms; however, the use of atropine prior to bronchoscopy may be justified in reducing the total amount of secretion and thus making the procedure easier for the patient.

Specifically, the use of the various agents described may be of distinct advantage in the treatment of certain diseases in manners determined through these studies. In bronchiectasis and in certain types of asthma in which bronchial obstruction plays a rôle in the symptomatology and pathology, frequent inhalations of carbon dioxide by mask, together with steam inhalations, may be used to augment the postural drainage and bronchoscopic aspiration which are fundamentally important. The use of steam and carbon dioxide between bronchoscopies, and especially shortly prior to bronchoscopy, is indicated if the sputum is known to be extremely thick and tenacious. Such therapy greatly enhances the action of any expectorant drug which is being administered.

In laryngotracheobronchitis, the use of a room kept at 70 to 75°F. with a relative humidity of 80 to 95 per cent provides satisfactory conditions for liquefying secretions. If, because of an increasing œdema, obstruction of the airway progresses in spite of the removal of secretions, oxygen may become necessary. In such instances adequate provision for a high degree of humidity in the oxygen tent is essential. The attachment of a mechanical humidifier to the tent in the manner suggested by Davison is the most practical means of accomplishing this.

Post-operative massive collapse of the lung, produced by the occlusion of a major bronchus by viscid mucus, is almost always spontaneously relieved if the patient can be encouraged to breathe deeply and cough. Steam inhalations aid in liquefying secretions and thus facilitate their removal, but carbon dioxide has become the most commonly used expectorant in the treatment of this disease because of its extremely efficient action in increasing the rate and depth of respiration as well as in aiding to liquefy the secretions. Actual bronchoscopic suction when these agents fail, or if the condition of the patient demands immediate intervention, must always be available.

The influence of the agents studied on the mucosa and inflammatory products of the nasal accessory sinuses has not been studied in detail. It remains to be seen whether an inflamed mucous membrane of the upper respiratory tract is similarly responsive to carbon dioxide when this action is not dependent on an actual increase in the respiratory movements.

## Reviews

**RECENT ADVANCES IN MEDICINE. CLINICAL LABORATORY THERAPEUTIC.**—By G. E. Beaumont, M.A., D.M. (Oxon.), F.R.C.P., D.P.H. (Lond.), and E. C. Dodds, M.V.O., D.Sc., Ph.D., M.D., F.R.C.P., F.I.C., F.R.S.E. Tenth Edition. 1941. J. and A. Churchill Limited, London. Pp. xiv plus 440, with 45 illustrations. Price, 18s.

THE appearance of a new edition of this extremely useful representative of Messrs. Churchill's now famous series has for some time been a biennial event, and we are very pleased that this periodicity has not been disturbed by recent events.

War stimulates medical science in some directions and retards it in others, but most of the advances recorded in this volume may be said to have been made despite the war rather than because of it. The chapters on advances along the three most promising lines, the sulphanilamide drugs, the vitamins, and the hormones, naturally required rewriting. In the case of the first-named, the authors have taken a conservative point of view, and have warned rather than enthused; this is perhaps necessary to counteract the uninformed and prejudiced publicity that has been given to these drugs.

Most chapters have been revised and additions have been made. The technique of sternal puncture appears for the first time. It is of course probable that this simple procedure can be performed satisfactorily in many different ways, but the description given does not suggest much practical experience on the part of the writers. There seems to be nothing to recommend oil sterilization; it will mean delay while waiting for the syringe to cool, it will make an already rather small instrument very difficult to control, and the oil will tend to interfere with the staining of the smear. Previous dry sterilization in a test-tube obviates all these disadvantages and introduces no new ones. And it is really ever advantageous to use a hammer? In an experience that is now approaching four figures, the reviewer has certainly never found it necessary.

The effect of the war appears in a section on plasma transfusion, but it is very doubtful if the apparatus for drying plasma that is shown is a satisfactory one. It certainly would not produce any dry plasma in this climate, and complete dryness is essential to ensure good keeping qualities.

This new edition in every way maintains the reputation of its predecessors.

**DIETETICS FOR THE CLINICIAN.**—By Late Milton Arlenden Bridges, B.S., M.D., F.A.C.P. Fourth Edition. 1941. Henry Kimpton, London. Pp. 960. Price, 45s.

To the medical student of thirty years ago, the word dietetics carried with it a suggestion of quackery or at least faddism, though he probably had an uncomfortable feeling that there was more in this diet business than his teachers seemed inclined to tell him, or he himself was able to find in his textbooks. Beyond being prepared to give some details of the Lenhart diet, he dealt in general terms, such as a 'low diet', a 'fluid diet', a 'milk diet', without any very exact idea of what constituted these diets. When he went into practice he found that his patients wanted more details than he was able to give and he had to pick up what he could from his fellow practitioners who had had longer experience. Other 'systems' of medicine, however, paid more attention to diet and though the practitioner of scientific medicine openly despised the empiricism of these 'rivals', he observed their results which were sometimes good, but he didn't know where to start to investigate the subject. Then vitamins were discovered. Here was something scientific; he accepted them with open arms, sometimes too open, but they provided the stimulus that was necessary, and to-day dietetics has become a subject of major importance in every branch of curative and preventive medicine.

The first edition of Dr. Milton Bridges' book came to a medical profession hungry for exact information on diet, dietetic values, etc. His book, first published in 1933, was an immediate success and new editions were demanded in rapid succession. The present, fourth edition, is, we regret to say, a posthumous one; but we are told in the preface that most of the edition was planned before the author died and there is certainly sufficient of the previous editions retained to make the book still essentially Bridges'.

There are three major divisions in the book—(a) general considerations, in which the physiology and chemistry of food are discussed and the different food factors are described: this part covers over two hundred pages; (b) dietetic management of disease in adults, which is self-explanatory and covers nearly four hundred pages; and (c) appendix consisting of tables—another three hundred pages. It is in the appendix that the greatest increase has occurred compared with earlier editions.

The book is a mine of information and an invaluable addition to a physician's library. The data are, of course, based on American standards, but with this book, Hutchinson's *Food*, *The Chemical Composition of Food* (Medical Research Council. Special Report

Series No. 235), and *Health Bulletin No. 23* (Government of India publication price 2 annas of which a new edition has just been published) the dietitian should be fully equipped and prepared to advise patients of almost any nationality.

**ESSENTIALS OF DERMATOLOGY.**—By Norman Tobias, M.D. 1941. J. B. Lippincott Company, Philadelphia and London. Pp. xii plus 497. Illustrated. Price, 28s.

This small book may be regarded as a dermatological dictionary and is well suited for rapid reference for those having some experience on the subject.

In his attempt to be concise the author has made the descriptions of the diseases so short that beginners will find it difficult to understand and use it in making a diagnosis, and from the simple enumeration of treatments without any explanatory notes they will be unable to form an idea of the line of treatment to adopt.

The diseases have been classified according to the symptoms or the regional distribution rather than on an aetiological basis. Urticaria and pityriasis rosea have been placed under erythemas; bacterial diseases have been put under two different headings, the pyodermas in chapter 7 and the deep infective dermatoses in chapter 14; seborrhoea has been described, both under the diseases of the hair and diseases of the sebaceous glands. The author has classified the spirochætal diseases, syphilis, yaws and Vincent's angina, as protozoal diseases, although spirochaetes are not protozoa.

Of the true protozoal diseases he has mentioned only a very rare condition 'amebiasis cutis' but has omitted the much commoner Leishmania infection of the skin. When climatic factors are mentioned the climate of the United States is the only one referred to.

The printing and photography are very good and the chapters have been well written and give

Chapter I the 'Basic survey' dealing with the history-taking, methods of diagnosis and cutaneous manifestations of systemic diseases; chapter IV 'Drug eruptions' and chapter XXXII 'Therapeutics' describing the various skin diseases.

The book may be regarded as a useful summary of the subject but on account of the deficiencies touched on above it is not likely to be of much value to tropical practitioners.

L. M. G.

**PICTORIAL MIDWIFERY: AN ATLAS OF MIDWIFERY FOR PUPIL MIDWIVES.**—By Sir Comyns Berkeley, M.A., M.C., M.D. (Cantab.), F.R.C.P. (Lond.), F.R.C.S. (Eng.), Hon. M.M.S.A., F.R.C.O.G. Fourth Edition. 1941. Baillière, Tindall and Cox, London. Pp. xii plus 165, with 244 illustrations. Price, 7s. 6d.

This is the fourth edition of a book which has now become one of the famous atlases of the literature of obstetrics. It is a great many years since the first edition was written and published, but the great majority of the well-known diagrams which illustrated that edition are reproduced in the volume under review.

There are many new diagrams portrayed in this last edition, and the author may be congratulated on the continuance of this pristine excellence.

The atlas will be of great use to all students of obstetrics.

H. E. M.

**SURGICAL NURSING AND AFTER-TREATMENT: A HANDBOOK FOR NURSES AND OTHERS.**—By H. C. Rutherford Darling, M.D., M.S., M.S. (Lond.), F.R.C.S. (Eng.), F.R.F.P.S. (Glas.). Seventh Edition. 1941. J. and A. Churchill Limited, London. Pp. x plus 726, with 207 illustrations. Price, 10s. 6d.

The first edition of this work was published in 1917 just before the end of the 1914-18 war, and it is



therefore evidence of its popularity that its seventh edition has now appeared having been completely brought up to date in accordance with modern methods of surgical nursing.

A book of this type is invaluable for it enables the medical student, as well as the nurse, to understand fully, certain apparently simple matters which are only too often barely mentioned in the textbooks. *Surgical Nursing* fills this want, and supplies a boon unknown to the last generation. A small criticism may perhaps be made when discussing the chapter dealing with splints; it is that many splints which are very little used at the present time are mentioned, but it is presumed that they are described purely from an academical standpoint.

This excellent treatise should be in the hands of every sister tutor, and any nurse or medical student

who knows thoroughly what is in this book will do well in his or her examinations.

H. E. M.

**AIDS TO TRAY AND TROLLEY SETTING.**—By Marjorie Houghton, S.R.N., S.C.M., D.N. (Lond.). 1941. Baillière, Tindall and Cox, London. Pp. xlii plus 203. Illustrated. Price, 3s. 6d.

*Aids to Tray and Trolley Setting* is a most valuable addition to the *Aids* series of books for nurses. The excellent illustrations of all ward procedures will enable the nurse to visualize her needs easily, and they supply an ideal way of teaching correct setting out of apparatus.

The theatre nurse will find the list of instruments at the end of the book particularly helpful as a guide to operation needs.

I shall have much pleasure in recommending the book to my student nurses.

## Abstracts from Reports

### REPORT OF THE SIXTY-SEVENTH YEAR'S WORK IN INDIA AND BURMA OF THE MISSION TO LEPERS, SEPTEMBER 1940 TO AUGUST 1941

Among the major events of the period under report was the retirement, at the age of seventy, of the Rev. Dr. P. A. Penner who began his work forty years ago. When Dr. Penner laid down the work in the spring of this year he left behind a model garden-town of over five hundred leper citizens, with its efficient hospital and treatment service, its well-developed social life and its out-patient work for those still able to maintain their home life. He left behind many who had been restored to health. And he left a large family of rescued children of destitute lepers, now useful and healthy citizens.

During the period under review another outstanding servant of the cause, the Rev. E. B. Sharpe, for nearly twenty years Superintendent of the Purulia Leper Home and Hospital, died at his post. Mr. Sharpe laboured incessantly to bring to his eight hundred patients the means of physical, mental and spiritual health. The erection of hospital wards and treatment centres for the care of the body; schools and recreation hall for the quickening of the mind; increased facilities for private and corporate worship—these represented the all-round effort of Christian realism which marked Mr. Sharpe's labours on behalf of those he so dearly loved. The last building he erected and completed this spring was, appropriately enough, a further house for the accommodation of young boys with leprosy in a contagious form.

It was inevitable that war should slow down fresh developments in the work. What is remarkable is that, despite rising prices, and the many claims of war on our subscribers, especially in Great Britain, it should yet be possible to record any extensions at all. Besides the new leper boys' ward at Purulia, further accommodation for healthy boys at Naini, Allahabad, was completed. Australia had a big share in both these projects. The assembly hall at Zamurradgani, Fyzabad, the gift of English friends, was completed this summer. Indian postal workers helped liberally towards the erection of the social hall at Manamadura in South India. And it was an Indian doctor who gave a fine ward at Chevayur, Calicut, for the care of those suffering from leprosy and tuberculosis—which was completed this summer. A residential crèche for tiny children at Chandkhuri, C. P., was opened early this year. For this Canadian friends are to be thanked. A new doctor's house at Moulmein, Burma, further medical

staff quarters at Vadathorasalur, a house for girls undergoing treatment for leprosy at Kothara, Ellichpur, are other additions of the period reviewed. All these buildings provide a striking commentary on the curiously persistent impression that the Mission to Lepers is only concerned with the destitute crippled leper. Because the Mission will not desert the needs of the most hopeless cases, that does not mean that its service is bounded by the care of such cases.

At the end of December 1940, 7,183 in-patients were in the Mission's Homes in India and Burma. This figure shows a decrease of a hundred compared with the number at the end of 1939. The number of healthy children being separately cared for also decreased from 836 to 789. The reductions do not indicate any lessening of need, but only that fresh admissions were cut down until numbers had come within scheduled accommodation, which had often been exceeded. The number of patients in aided homes, 2,472, showed a slight increase and the Mission's financial help to them was maintained undiminished.

Medical results still fall far short of what we would wish, but there is encouragement in the fact that of 10,181 cases treated during the year as in-patients, and of whom records are available, 1,092 were declared 'disease-arrested' before deformity had begun. Another 596 were declared 'disease-arrested', but with deformity.

### TRIENNIAL REPORT ON THE WORKING OF HOSPITALS AND DISPENSARIES IN THE PUNJAB FOR THE YEARS 1938, 1939 AND 1940

In spite of the financial stringency occasioned by famine and war the triennium under review witnessed a considerable extension and expansion in institutions devoted to medical work. During this period 91 (75 in 1940 alone) new dispensaries were opened, and 13 closed down, with the result that at the end of it there were 1,046 hospitals and dispensaries (767 in rural and 279 in urban areas functioning in the Province compared with 968 (693 in rural and 275 in urban areas) at the close of the preceding triennium. The increase took place mostly in rural areas. Ten hospitals were provincialized (5 each in the years 1938 and 1939) making a total of 54 such hospitals. Thus, of the hospitals to be provincialized under the scheme of 1925-26, only 57 remained to be accorded that status. The number of beds in all kinds of hospitals has increased from 11,117 at the end of 1937 to 11,698 at the close of 1940—an increase of 581.

Under the scheme of 1925-26 it was intended to set up 375 rural dispensaries in the Province. Of this number 364 have actually been established so far. Experience, however, has shown that the benefits which the real village folk derive from the rural dispensaries or the subsidized dispensaries are by no means commensurate with the cost involved in establishing and maintaining them. So a new scheme was formulated in 1938, which combined inexpensiveness with adequate utility. Under this scheme a medical practitioner is settled in a village and paid Rs. 1,200 per annum (Rs. 600 for drugs, dressings, etc., and Rs. 600 for his services). One-half of this sum is provided by Government and the other half has to be found either by the District Board and/or by the local villagers—often organized as members of a Medical Co-operative Society. This scheme, which places the benefits of scientific medicine within the reach of villagers at a nominal cost, has found general favour. It is, therefore, proposed to add 34 men and 5 women practitioners in the coming year to their present number, 83. Apart from this scheme, which is likely to become the basic medical organization of the future, the sphere of usefulness of the already existing rural dispensaries has been greatly enlarged by requiring, since 1938, the medical officers in charge to go round and treat the sick in key villages (within a radius of 5 miles of their dispensaries) on certain days in the week. For defraying the cost of journeys the doctors are paid a fixed allowance of Rs. 10 per mensem. It is significant to note that 359,796 patients were treated in villages by doctors in charge of rural dispensaries.

During the triennium under review medical work for the exclusive benefit of women made notable progress. At the close of the last triennium there were only 97 medical institutions for women, but they have now increased to 130 (50 women's hospitals, 61 sections and 19 dispensaries). There has been a corresponding increase in the cadre of assistant and sub-assistant surgeons. As mentioned earlier, it has also been decided to recruit women subsidized medical practitioners. To encourage the study of medicine among girls the Punjab Government meet the capitation charges of five

Punjabi students at the Lady Hardinge Medical College, New Delhi, and award four scholarships of Rs. 20 per mensem each for L.S.M.F. students. Besides, out of the Countess of Dufferin's Fund 21 scholarships of Rs. 30 per mensem each are available for M.B., B.S. students and 28 scholarships of Rs. 15 per mensem each for L.S.M.F. students. The education department also award a number of scholarships. On the welfare side too a notable advance has been made. A sum of Rs. 60,000 was sanctioned by Government to provide scholarships for the training of 100 nurse *daïs* and 200 trained *daïs*. In the capital of the Province there has been inaugurated a midwifery district in association with a welfare centre attached to the Lady Willingdon Hospital. This, in addition to providing facilities in improved midwifery for women in their homes, assists in the training of medical graduates and of *daïs*. The experiment having proved successful the organization of a second district has been sanctioned. Training of health visitors and *daïs* continues to be prosecuted with zeal, and health centres are ever growing in popularity.

As noted in the last triennial report there are five leper homes in the province, but the number of leprosy clinics has risen from 100 to 180. The problem of how to rid the homes of non-Punjabi lepers still remains unsolved. A partial remedy may be provided by the decision that in future lepers hailing from other provinces or states will not be admitted to leper homes in the Punjab except on a certificate from a civil surgeon to the effect that they are in a dangerously infective condition.

It is gratifying to note that the people are becoming more and more alive to the necessity of detecting, controlling and curing tuberculosis. Some philanthropically-minded persons have made handsome contributions for fighting this scourge.

The report of the Committee appointed by Government to enquire into the question of instituting a register of practitioners of indigenous systems of medicine and of devising steps for improving their medical education has been received and is under consideration.

## Service Notes

### APPOINTMENTS AND TRANSFERS

The Governor is pleased to appoint Major-General W. C. Paton substantively as Surgeon-General with the Government of Bengal, with effect from the 23rd August, 1941, *vice* Major-General P. S. Mills, K.H.P., C.I.E., retired.

The undermentioned to be Honorary Surgeons to the King:—

Colonel T. C. Boyd, V.H.S. Dated 14th February, 1941, *vice* Colonel J. Taylor, C.I.E., D.S.O., I.M.S., retired.

Colonel H. J. M. Cursetjee, D.S.O., V.H.S. Dated 23rd February, 1941, *vice* Major-General N. M. Wilson, C.I.E., O.B.E., I.M.S., retired.

The services of Lieutenant-Colonel J. Rodger, O.B.E., M.C., an Agency Surgeon, are temporarily replaced at the disposal of His Excellency the Commander-in-Chief, with effect from the forenoon of the 20th October, 1941.

Lieutenant-Colonel A. S. Leslie, I.M.S. (retired), is re-employed as Residency Surgeon, Kashmir, with effect from the forenoon of the 20th October, 1941.

Lieutenant-Colonel W. M. Will is appointed Deputy Assistant Director-General (Medical Stores), Medical Store Depot, Madras, with effect from the afternoon of the 25th November, 1941, *vice* Major B. N. Khan placed on Special Duty.

Lieutenant-Colonel C. M. Ganapathy, M.C., C.I.E., I.M.S. (retired), is appointed to officiate as Port Health Officer, Bombay, with effect from the 1st December, 1941, *vice* Major C. A. Bozman granted leave.

Major B. A. Porritt is appointed Additional Officer at the Medical Store Depot, Bombay, with effect from the 24th November, 1941.

Major B. N. Khan is appointed officer on Special Duty, with effect from the afternoon of the 25th November, 1941.

The undermentioned officers retire with gratuity and are granted emergency commissions from the dates specified:—

### INDIAN LAND FORCES

#### (Short Service Commission)

Captain I. Mallik. Dated 7th December, 1941.

Captain M. S. Rao. Dated 9th December, 1941.

#### (Permanent Commissions)

##### To be Captains (on probation)

Kamarazu Narasimha Rao. Dated 7th September, 1941, with seniority from 1st July, 1936.

Sleem Ahmad Mian. Dated 29th October, 1941, with seniority in his present rank from 29th October, 1936, and in the rank of Lieutenant from 29th October, 1935.



Sayed Ahmad Hasan. Dated 22nd December, 1941, with seniority in his present rank from 22nd December, 1936, and in the rank of Lieutenant from 22nd December, 1935.

Sailendra Mohan Basu. Dated 4th January, 1942, with seniority in his present rank from 4th January, 1937, and in the rank of Lieutenant from 4th January, 1936.

(Emergency Commission)

The undermentioned Lieutenants (on probation) is confirmed in his rank, with effect from the date specified:—

M. S. Yehya. Dated 23rd September, 1940.

INDIAN MEDICAL SERVICE (DENTAL BRANCH)

The undermentioned Lieutenants (on probation) are confirmed in their rank, with effect from the date specified:—

1st February, 1941

|           |                 |
|-----------|-----------------|
| M. Ahmad. | S. N. Mohammad. |
| R. Sethi. | M. Qureshi.     |
| K. Singh. | V. O. Arathoon. |
|           | J. Singh.       |

The undermentioned appointments are made:—

To be Lieutenants

Raymond Thomas Hinde. Dated 14th August, 1941, with seniority from 14th August, 1940.

Paul Stephen Clarke. Dated 14th August, 1941, with seniority from 14th August, 1940.

Emrys Lloyd Jones. Dated 21st August, 1941, with seniority from 21st August, 1940.

Denis Goodwin Horan. Dated 14th August, 1941, with seniority from 14th August, 1940.

Thomas Douglas Brown. Dated 14th August, 1941, with seniority from 14th February, 1941.

Peter Neville Swift. Dated 14th August, 1941, with seniority from 14th February, 1941.

William Thomson. Dated 14th August, 1941, with seniority from 14th February, 1941.

Andrew Donald Wilson. Dated 10th July, 1941, with seniority from 10th January, 1941.

Iain Alasdair MacMillan Beaton. Dated 10th January, 1941.

PROMOTIONS

INDIAN LAND FORCES

(Emergency Commission)

Lieutenants to be Captains

M. S. Yehya. Dated 23rd September, 1941.

2nd December, 1941

|                      |                              |
|----------------------|------------------------------|
| H. K. Khalil.        | H. P. B. Neku.               |
| P. F. D'Souza.       | V. G. Pande.                 |
| P. K. Kar.           | Bimanesh Bhushan Chatterjee. |
| U. Mazumder.         |                              |
| B. B. Biswas.        | G. S. R. Reddy.              |
| M. K. Siddiqui.      | P. G. Tampi.                 |
| E. J. Ramdas.        | F. B. Laher.                 |
| J. H. Joshi.         | Bibhuti Bhushan Chatterjee.  |
| G. B. Godbole.       | N. Subrahmanyam.             |
| S. K. Lal.           | M. K. Chaudhary.             |
| Y. K. C. Pandit.     | C. A. Rajamani.              |
| K. S. B. Menon.      | S. A. Qadir.                 |
| A. K. Bose.          | M. N. Sen.                   |
| T. P. Sundaram.      | S. V. Grade.                 |
| V. V. Narayanamurti. | N. G. Ajgaonkar.             |
| S. V. Ghurye.        | N. G. A. S. Raghavan.        |
| V. D. Shah.          | J. G. Rodrigues.             |
| S. S. Kirtane.       | M. A. R. Chaudhari.          |

3rd December, 1941

S. D. Malaviya.

N. T. Ghaisas.

## Notes

### AVITOL

In our Notes section in the December 1941 issue under the heading of 'Avitol' we referred to a fish-liver oil under the name Shaliverol. We are informed that the name of this product has now been changed to Sharliverol.

## Publishers' Notice

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## Original Articles

### MAGNESIUM SULPHATE POWDER IN THE TREATMENT OF WOUNDS AND ULCERS

By A. T. ANDREASEN, F.R.C.S.  
MAJOR, I.M.S.

THE standard treatment of all wounds and ulcers in India at present depends upon some form of chlorine solution for its mainstay, with the frequent application of dressings.

The wounds met with are often extensive and almost always very foul. Many are the result of neglect of abscesses, ulcers, and knife, axe or other wounds; others owe their foulness to the application of such village cures as plasters of leaves and mud, cow-dung plasters, etc. The ulcers are mainly chronic with considerable fibrosis around the edges and bases; the granulations, if visible, are pale, hard and coarse. Large abscesses and septic joints are very common in Indian practice. They are generally treated along similar lines with chlorine solutions, irrigations, and daily or twice daily dressings. In my experience, such wounds and ulcers do not heal very rapidly with any of the chlorine antiseptics, no matter how frequent the dressings.

In the chronic cases, I felt that no good was being done, judging by the slow progress of the cases, and that in all probability much harm was caused by the powerful action of chlorine upon the growth of young tissue cells, making a feeble effort at repair. I have always felt that frequent dressings, wet or dry, were more of a hindrance to Nature than otherwise, in both acute and chronic cases. The fashion of washing away all discharges as 'dirty' has always caused me to think that the old cult of 'laudable pus' is deeply ingrained in many of us, certainly more deeply than any physiological principle of the healing of tissue. However, this was mere conjecture. Hypothesis arose because nowhere could I find at that time (1931) any literature concerned with the study of healing of wounds, using the rate of cell growth as an index of the efficacy and propriety of any method of treatment; all workers had been concerned with the elimination of bacteria and the inhibition of their growth. Because wounds heal whilst subjected to treatment with this or that antiseptic is no indication that the antiseptic in question has any particular specific destructive action on bacteria whilst exercising a stimulative or protective action upon the delicate growing and proliferating cells. Rather are these experiments a demonstration of the extent of maltreatment the body will suffer and Nature overcome.

On the one hand, we had been taught as students that, in response to an invasion by an organic irritant, Nature brings up a large and

remarkable force of combatants, specialized and general; that, allowed to go far enough, the fluid containing this army of Nature became an opaque yellow colour and of a thick consistency, *but that the fight went on continuously in this fluid*. Given a reasonable chance, Nature would always win. We were taught that at the same time as the combatants, reconstruction units were marshalled, in the rear, and set to the work of repair immediately, and that certain chemicals in the fluid medium in which these reconstructive units moved, aided and stimulated their activities.

On the other hand, having left the realms of science and moved into the practical sphere we were taught that this day-dreaming was all very well but practical surgery required that the practitioner should 'get on with the job'. We were taught to 'clean' the wounds daily, or more often. It was a sign of neglect to have a pus stain on the gauze dressing. Wounds were irrigated, 'cleaned' with swabs soaked in antiseptics of all kinds, and all judged for their bactericidal power rather than their growth-promoting properties. The two sides of our teaching did not meet. The practitioners were failing to apply the advances of physiology, embryology and pathology to their daily work. Their work was becoming a mere meaningless ritual based on beliefs, having their origin in the dark ages.

At precisely this point, when the writer was realizing the presence of this gap in our application of knowledge to practice, he had the opportunity of working under Dickson-Wright. To him I owe much. His stimulating and reactionary ideas on the treatment of varicose ulcer gave me much food for thought. In his clinic I saw huge ulcers heal visibly under elastoplast, where for months and years no signs of healing had been evoked by any other form of dressing. The ulcers were put at rest, the cells allowed to grow quickly under the stimulus of the vital tissue juices, and elastic pressure necessary for all organized growth was exerted. At the same time as the part was put at rest, active exercise was possible for the limb without disturbing the local condition, and so promotion of blood supply, with all the improvements attendant upon that vital requirement of life and healing, was invoked.

Now, elastoplast is not available to the poor of India, in or out of hospital, as it is too expensive; yet large sums of money are spent on a variety of rather doubtful antiseptic. There are, however, more rational methods, cheaper and easily available.

If a dry gauze dressing is placed over a clean ulcer for 12 hours, then removed and rinsed continuously for 30 minutes in normal saline, and the resulting washings centrifuged, there will be found a small collection of white material, which, when spread on a slide and stained with Leishman's stain, proves to be nothing but millions of young fibroblasts. This is sufficient demonstration of the destruction of

Nature's reparative efforts caused at each single change of dressing alone. It would appear then to be rational to let the dressing stay in position as long as possible. How long? Ideally until healing has occurred.

Next, take a little pus from the base of a foul wound, place it in a vaseline ring under a coverslip with a drop of saline to make it sufficiently dilute to transmit light. Place the slide on a warm stage and observe under a microscope what happens. Phagocytes will be seen moving about engulfing particles of debris and bacteria. Many other types of white cell can be seen; and when a smear of this pus is stained, there are certainly many dead cells, *but many more are living cells*, judged by their staining reactions. The bacteria present mostly show signs of degeneration, let it be noted. If the pus was taken very close to the base of the ulcer then many living fibroblasts, few dead cells, and *no bacteria* are found.

It would, then, seem that inside this medium much of Nature's offensive, defensive, and repair work is going on. Why disturb it without any knowledge of what good we are doing, and with much evidence to hand, that, by such action, we, at best, only retard the healing process?

Every one knows the successful outcome of proper application of the Winnett-Orr technique, both in osteomyelitis and in its recent application to compound fractures and war wounds. All of us know the principle underlying the technique.

Thus, the requirements of a rational method of treatment of wounds received in hospital *after the lapse of the period* where primary excision and suture, or excision and packing with vaseline, followed by complete immobilization of the part, could be safely carried out are :—

1. Some form of dressing which accelerates the transport to the part of Nature's forces, without offering any hindrance to their action.
2. This form of dressing must be capable of being renewed without disarranging the growing cells.
3. It must allow the part to remain perfectly immobilized.
4. It must be easily available and cheap; easily prepared.
5. It must be applicable to all types of wound, however infected.
6. It must 'clean' the wound rapidly, *i.e.*, bring it to a stage of healthy granulation where the vaseline technique of Winnett-Orr or the elastoplast technique of Dickson-Wright may be used for the final stage of complete epithelialization.

In short, the primary treatment corresponds to the primary excision of the wound; *plus* the fact that it brings about an early stage of healing, and finishes when healthy granulation has occurred. Searching for a substance to fulfil

these conditions, I hit upon magnesium sulphate, thinking that its hygroscopic powers could be used to draw out the tissue fluids with their content of essentials for healing. I first used a saturated solution on gauze. This had the disadvantages in that the dressing was wet, required frequent changing if its power was to be maintained, and hence continually disturbed the wound and removed millions of fibroblasts at each change of gauze, even when left in place for 24 or 48 hours, for the cells grow rapidly along the cotton fibres. It was however a distinct improvement on any other dressing I had used up till then.

Next, I used the crystalline salt, pure, on the wound. This is a slightly painful dressing on the first occasion, but after that there is little or no pain. The pain is always described as a 'drawing' sensation.

The disadvantage of this dressing was that it was difficult in a humid tropical climate to keep the salt dry. Unless absolutely dry, I believe that the effect of the dressing is reduced by at least 50 per cent, for I found that if the crystals are finely powdered and dried carefully before every application, the results were twice as rapidly attained with no more discomfort to the patient.

My technique of dressing is as follows :—

1. Excess of pus and crusts is cleared gently from the edges of the wound with gauze and forceps. Any thick crust or creamy pus is gently lifted away from the centre with the forceps or a spatula, without disturbing the essential layer covering the base of the wound or ulcer which contains all the growing cells.
2. The finely powdered, absolutely dry magnesium sulphate is then poured liberally directly into the wound so as to cover it completely.
3. Over this a light layer of gauze and wool is placed and bandaged firmly with a small many-tail bandage. At the second dressing, which may be done in 12 hours, the many-tail bandage obviates the disturbance caused by undoing a roller bandage. A large amount of fluid will be found to have been drawn out, soaking the gauze and wool, at the first and second dressings.

Excess of wet salt is gently lifted off with a spatula and fresh dry salt applied, without disturbing the underneath layer of salt now in contact with the base of the ulcer or wound. Fresh gauze and wool are bandaged in place as before.

Usually after the first dressing there is no discomfort at the application of the salt, beyond a warm tingling sensation which lasts about 10 minutes.

After four such dressings, there is usually need of changing only once in 24 hours.

At the end of 4 or 5 days, a large ulcer, perhaps previously fouled with cow-dung and with a thick slough on the base, will be

found covered by a thin crust of magnesium sulphate impregnated with serum, cells, etc. If one edge of this is gently raised, a beautifully red-velvet bed of granulations will be seen where before was foul slough; a pale bluish-white edge of growing epithelium is showing at the edges of the ulcer. I have seen diabetic carbuncles and diabetic ulcers respond quickly to this treatment; I have seen ulcers from which gas-forming organisms, tetanus, and virulent streptococci were grown, clear and become healing ulcers inside 8 to 10 days of such treatment.

A limb with a large ulcer, or foul compound fracture, or septic joint, can be easily immobilized in a plaster case with a window during this primary stage of treatment; such cases transport well. The dressing need not be touched during transport.

When the ulcer bed shows these healthy granulations, the crust of salt is raised gently and lifted off. A thick layer of sterile vaseline is laid over the ulcer bed and edges; over this a light layer of gauze and wool, and a firm roller bandage, or, if available, best of all a complete plaster case. This dressing is left in place for at least 10 days. In the hot damp weather of the Indian plains I found that five days was a better period, as the smell in the heat was practically unbearable. There is no breeze, and verandahs are too hot to put the patients on. In the cold season 10 days is easily tolerated. In the hills and cold parts the case can be left until healing is complete—about 20 to 30 days, according to the size and depth and situation of the wound.

Healing is rapid, scarring is minimum and often nearly absent. Scars are always pliable and freely movable over the underlying parts.

The method is cheap, easily carried out, always available even in the remotest stations, the materials are easily carried in war, there being no necessity for solutions and bottles, and it is the most efficient method I know of for cleaning and healing foul, badly-infected wounds. It is far more effective than the solution of the salt. Either magnesium or sodium sulphate may be used; they are equally effective. Magnesium sulphate is more often available.

For over eight years now I have used this technique exclusively. The subdivisional hospitals and dispensaries under my administration all use the method and rely upon it exclusively. Thus, annually, some 4,000 or 5,000 septic cases are treated by this technique, under my direction, and many under my personal care. The stay in hospital of the average large and grossly contaminated wounds has been reduced from 74 days to 21 days. By large, I mean wounds of a surface area of over 6 inches by 6 inches and a depth of 1 inch. Smaller wounds show a correspondingly shorter hospital stay. The method allows of earlier discharge

(Concluded at foot of next column)

## THE PREPARATION AND USES OF CELLULOID SPLINTS

By G. E. DUNKERLEY, M.B., B.S. (Lond.)  
Assistant Medical Officer, Kolar Gold Field

MANY materials are utilized in the making of splints. The word splint means 'a small piece of wood split off', and wood is still popular for temporary fixation, especially in first aid. In orthopaedics, plaster of paris is more frequently used than any other retentive apparatus. Its great usefulness depends on its adaptability and on the ease of securing immobilization by maintaining any desired position for only a few minutes during setting. Excellent articles on the technique of using plaster have recently been published by Girdlestone (1940) and by Stonham (1941). It has, however, certain disadvantages, which are formidable obstacles to its use in some conditions, for instance in the

(Continued from previous column)

and early assumption of function, since the patients can be discharged in plaster, and return for a change once or twice until healing is complete. Many of the smaller ones, of course, require no plaster, merely firm bandaging, a sling, etc.

Many of my colleagues, having seen the method in operation, have adopted it for their own practice.

It will be seen that it fulfils all the requirements of a good dressing as defined above. In war, it should prove invaluable, since it is noteworthy that I have not yet seen a case of tetanus or gas gangrene in any case treated by this method, during these eight years.

This type of dressing may be used in any part of the body, for any type of wound. I have used it in treating dirty gun-shot wounds, or gun-shot wounds of regions, and of types difficult to excise completely, with constant success.

In children, I mix an equal portion of boracic acid powder with the magnesium sulphate to take the sting out of the first dressing. Since the introduction of sulphonamide and sulphapyridine preparations, I have used them with the treatment freely, where indicated, without any bad result. Naturally, wounds of the face or jaw opening the buccal or lingual mucous membrane cannot be given those drugs. However, these cases respond particularly well to magnesium sulphate treatment, and it is rarely necessary to think of giving sulphonamide.

I contend that here is a simple, always available, cheap, most effective and efficient dressing, employing and aiding Nature's forces in the process of eliminating infection and of promoting rapid sound healing—a dressing allowing the practice of all first principles, a dressing based on the application of physiological knowledge rather than on cult, or fashion, or prejudice, a type of dressing worthy at least of the attention and trial of any thinking surgeon.

convalescent stage of anterior poliomyelitis. These are:—

(1) A plaster cast cannot be removed and re-applied for treatment, such as active or passive movements, massage, electrical therapy or cleansing of the patient. Wasting necessarily occurs.

(2) It becomes soiled and loses its consistency owing to moisture from the patient's excretions, particularly in young children.

(3) Plaster sores may appear. When plaster is in use for a long period the development of this unhappy complication cannot be avoided notwithstanding scrupulous attention to technique. The muscle wasting which is inevitable with time makes the plaster cast loose, resulting in friction between it and the skin. This is a more frequent cause of plaster sores than the pressure of newly made casts.

(4) The durability of a plaster case is limited.

(5) The weight of a strong plaster is a considerable drawback resulting in discomfort, physical and mental.

Iron or steel and leather are useful in apparatus for prolonged usage such as spinal jackets, callipers and hip splints. The disadvantages of weight and clumsiness are serious, and special experience is needed to work in these materials. If iron is replaced by aluminium or one of its alloys greater expense is incurred. For spinal jackets, collars and sacro-iliac belts proplastic felt is of considerable use. It is available in sheets which, when subjected to moist heat, become plastic and set on drying. It is an unsuitable medium for use in this country as it is heavy, hot and difficult to keep clean. Starch bandages and waterglass bandages have been widely used in making light splints for the treatment of fractures but have been superseded by plaster of paris.

Celluloid is an ideal substance from which to prepare splints since it is light, rigid and washable, and a wider use of it is urged. Celluloid splints may be made in various ways. It may be obtained in thin sheets which are rendered plastic by macerating in warm spirit for a few minutes, and may then be wrapped round a limb with a layer of cotton-wool outside, when it quickly sets. A special solution called pexuloid is used at the Hospital for Sick Children, Great Ormond Street, London. Celluloid by itself is somewhat brittle and is not easily moulded. The splint described here is not brittle as the celluloid is reinforced with woven material. Though much more arduous to make than a plaster cast it possesses the same attribute of adaptability and in addition to these advantages it is: (1) light, (2) durable, (3) washable, (4) easily and quickly removed and replaced, and (5) fairly cheap to make.

These splints are expensive when supplied by a splint-maker owing to the amount of time and labour involved, but the materials themselves are cheap.

The celluloid splint is especially valuable when some form of retentive apparatus must be worn for a long period, when it is desirable to avoid wasting and to allow remedial exercises, and when, as in children, soiling from excreta is likely. It is commonly used in the following conditions:—

(1) The convalescent stage of anterior poliomyelitis.

(2) The quiescent stage of bone and joint tuberculosis.

(3) In certain fractures requiring prolonged immobilization, for instance, of the carpal scaphoid.

In addition, it is suggested that it would be invaluable in the treatment of post-traumatic paralyses. A number of such cases is likely to arise in the present war and this splint is ideal for maintaining paralysed muscle groups in a suitable state of relaxation during the months which must elapse before recovery can be expected. At the same time local treatment such as massage and exercises is facilitated. A leg splint may be used for walking if the sole and heel are reinforced with leather.

The writer has used the celluloid splint with success in the following conditions:—

(1) Lower and upper limb paralyses following anterior poliomyelitis.

(2) Quiescent tuberculosis of the knee joint and of the spine.

(3) After correction of flexion contracture of both knees.

### Method

A plaster shell of the part is first prepared. From this a cast or model, analogous to a shoe-maker's last, is made, and on this model the splint is built up (Mercer, 1936).

*Preliminary shell.*—The ultimate shape and function of the splint are determined by the position of the body and limb during the making of this shell. The part of the body for which the splint is required is therefore placed in the most advantageous posture, paying heed to the usual rules if ankylosis of a joint is expected or if paralysed muscles are present. Next, strips of lead one and a half inches wide are bandaged down the sides of the limb in the position where the shell will be cut for removal. This permits cutting without danger of injury to the patient and without appreciably altering the shape of the plaster (plate V, figure 1).

Plaster bandages are applied without tension, and are carefully rubbed in and moulded over the bony prominences. The lead strips lie between this plaster and the skin and their outline should be discernible. Only a few thicknesses of plaster bandage, sufficient to form a rigid shell after removal, are necessary (plate V, figure 2). The plaster is allowed to dry for a few minutes. Transverse blue pencil lines are drawn over the site chosen for cutting in order to make reconstruction of the plaster accurate (plate V, figure 3), and bivalving is effected by cutting

over the strips (plate V, figure 4). The two halves are then placed in perfect apposition by restoring the continuity of the blue pencil lines and are united by further bandages placed round the plaster. This plaster shell of the part for which a splint is required is allowed to dry for a day or two (plate V, figure 5). If the plaster does not extend beyond the trunk, *e.g.*, when making a sacro-iliac bell, only one side need be divided for removal (plate V, figure 4).

*Cast or model.*—Openings in the shell, except the largest, are closed by means of suitably placed plaster bandages. The openings for the hand or toes are not closed in order to allow filling of the narrow portions; for instance, in a shell of the trunk and one leg the opening for the other leg is closed at the hip; in a shell of the trunk alone the lower opening is closed; in a shell of the leg and foot neither opening is closed. When the completed shell is dry the inside is coated with a layer of vaseline or soft soap to prevent the filling, that is shortly to be poured in, from adhering. In doing this, the frayed ends inside, where the plaster had previously been cut, are well rubbed down to form a smooth surface. The vaseline is applied with an applicator made from a stick with a bandage wound round the end. Stout iron wires are prepared to reinforce the cast and prevent breaking. In a cast of the leg and trunk one wire runs from the upper opening to the foot, another stout wire from the ankle to the toes and another in the trunk only. These wires are placed in position in the vaselined shell. The material for making the cast is then prepared. Cement is many times cheaper than plaster of paris and should be used for this purpose. If plaster is used it should be of a cheap variety otherwise the cost of the splint will be unnecessarily great. A mixture of plaster and cement, which is less brittle than cement alone, may be used in narrow places.

Some cement is placed in a basin and quickly mixed with water to make a paste of such a consistency that it will run. An assistant supports the shell with one hand held loosely over the lower opening and the paste is poured in. If necessary it may be pressed down with a wooden rod. When the cement reaches the assistant's hand it is held tightly to prevent the cement running out. If the shell is not completely filled a further quantity of cement is prepared and poured in, but the cast is less likely to crack later if all the cement is prepared at once. The top is finished off level so that the cast can stand on it. This facilitates subsequent procedures.

After drying for two or three days the cast is removed by dividing the plaster bandages where the shell was cut in removal from the patient. The cast is rough and irregular and in some places may not have completely filled the shell. It is made smooth with a coarse file or rasp, the dust cleaned off, and plaster of paris

cream rubbed on to make a thin evenly-spread surface. The comfort of the final splint depends to a considerable extent on this procedure, a layer of plaster one-eighth of an inch thick being advisable, especially in growing children. If this layer is omitted the splint made is skin tight and may press unduly in certain situations. The sites of bony prominences should be slightly accentuated at this stage and they must never be filed off in the preliminary preparation. The subsequent comfort of the patient must be carefully borne in mind whilst the cast is being finished off in this manner. The impression of the buttocks is often distorted and in making the cast the normal gluteal outline should be restored. The finished cast is allowed to dry for a day or two, care being taken not to crack the outer layer of plaster (plate V, figure 7).

*The splint.*—The splint itself is made by placing on the cast successive layers of butter muslin impregnated with celluloid. A solution of celluloid in acetone is first made. Acetone costs approximately twelve annas a pound and one pound is sufficient for about three coats on an average-sized splint. The celluloid is obtained from old *x-ray* films or waste film from cinematograph studios. The latter costs from twenty-five to forty rupees per hundredweight. Modern *x-ray* films of non-inflammable-type are unsuitable as they consist of cellulose acetate which is less soluble in acetone than celluloid. To prepare an old *x-ray* film for use it is soaked in warm water for an hour and then the emulsion scraped off both sides with a sharp instrument. The film is next cut into small chips and shaken up in a well-stoppered, wide-mouthed bottle or jam jar of acetone. Sufficient celluloid is used to form a saturated solution and to leave an undissolved residue, otherwise the solution is thin and too much acetone is used. About one and a half *x-ray* films twelve by fifteen inches in size may be dissolved in one pound of acetone and eight or nine such films will be required for an average splint.

Butter muslin is cut into strips three inches wide and rolled into the form of bandages. The end of one of these bandages is placed on the surface of the cast and the celluloid solution is painted on with a one and half inch brush. The acetone quickly evaporates leaving the butter muslin impregnated with celluloid adhering to the cast. The bandage is gradually unrolled to go round the cast in a spiral manner, the adjacent edges should just overlap, and the solution be painted on as the bandage lies on the cast. When the first layer is completed one or two additional layers of solution are applied in order to saturate it with celluloid. Each layer must lie evenly on its predecessor and the bandage may be frequently incised with a knife in order to ensure that it lies neatly, and to avoid the inclusion of air spaces. When a glossy film of celluloid can be seen covering one layer, another roll of butter muslin is painted on and the process repeated until thirty layers of butter muslin



have been used. An additional coat of solution is then applied to enhance the final appearance.

The splint is now ready for removal from the cast. This is done by cutting it in two halves down the sides in such a situation as is deemed suitable, bearing in mind that the splint will be worn in these two halves buckled together. The splint is pulled off the cast, the adherent plaster inside scraped off and a further layer or two of solution placed inside to give a smooth finish. Whilst this is drying the halves of the splint are placed on the cast to counteract a tendency for this layer to contract and narrow the splint.

The next stage is fitting the splint on the patient. The halves are placed in position and the upper and lower ends marked and later trimmed with strong scissors or a knife. Any other places which require trimming are then dealt with.

A number of quarter-inch holes are drilled in the splint for ventilation purposes (plate V, figure 10) and it is handed to the shoe-maker for completion. The edges of both halves of the splint are bound with leather which is stitched on, and straps and buckles are placed on the splint in suitable positions (plate V, figure 6). It is convenient to have one side of the splint fastened with straps and buckles and the other permanently attached by leather straps acting as hinges (plate V, figure 9). When a splint for the leg and foot is made in this way a strip must be cut off its medial side on the dorsum of the foot to allow ease in applying and removing the splint (plate V, figure 8). In splints for the hand and forearm a separate opening is necessary for the thumb which should not pass out between the halves. When making a shell for a sacro-iliac belt or a spinal jacket it should be heavily moulded into the soft parts above the iliac crests (plate V, figure 5).

#### Summary

(1) Brief mention is made of the materials commonly employed in the manufacture of splints, and attention is directed to certain disadvantages in the use of plaster of paris.

(2) The advantages of celluloid for making splints are discussed, and the type of case in which this medium is particularly useful is indicated.

(3) A method of constructing celluloid splints is described in some detail.

I have pleasure in acknowledging my indebtedness to Dr. W. B. Roantree, Chief Medical Officer, Kolar Gold Field, for his kind help in preparing this article, and my thanks are due to Messrs. John Taylor & Sons, the Managers, for permission to publish it.

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#### SIMMONDS' DISEASE

By R. VISWANATHAN, B.A., M.D., M.R.C.P. (Lond.),  
 T.D.D. (Wales)

King George Hospital, Vizagapatam

IN 1907 Paulesco demonstrated that removal of that pituitary gland caused weakness, loss of weight and death. In 1914 Simmonds reported the first case of the disease called after his name. A woman aged 38 years, after recovering from puerperal sepsis, developed amenorrhoea, increasing weakness, progressive loss of weight, anaemia, and premature senility. He put it down to atrophic degeneration of the anterior pituitary, due to septic emboli. Adequate reviews and compilations of Simmonds' disease have appeared in the medical literature during recent years, notably by Silver (1933), Calder (1932) and Graubner (1925). Farber (1940) reported a case in which he found *post mortem* marked microsplanchnia of all organs, and a pituitary stalk tumour (cystic epithelioma) which was evidently causing pressure atrophy of the anterior pituitary. Though previous reports were mainly based on post-mortem diagnosis, during recent years cases have been reported which successfully responded to replacement therapy with anterior pituitary extract. Dunn (1936) and Moehlig (1936) have reported cases of cure effected by anterior pituitary hormone therapy. Bergmann (1934) described a number of cases of emaciation and leanness which responded to pituitary.

**Ætiology.**—Post-mortem finding of anterior pituitary degeneration or atrophy is proof positive of the ætiological factor operating in Simmonds' disease. The atrophy is caused not only by septic emboli, as in Simmonds' own case, but also by syphilis, tuberculosis, pressure by tumour, etc.

**Symptomatology.**—The disease starts insidiously usually during maturity, characterized by cachexia of a remarkable degree. Wasting is so great that the patient is reduced to practically skin and bone. Premature senility sets in with loss of, or grey, hair, falling out of teeth, and dry, wrinkled, toneless skin. There is subnormal temperature. Pulse is slow and feeble. Blood pressure is very much below normal. Sugar tolerance and basal metabolism are diminished. The patient usually does not exhibit any sensation of thirst or hunger.

#### DESCRIPTION OF PLATE V

- Fig. 1.—Strips of lead bandaged in position for making a shell for a spinal jacket.  
 Fig. 2.—Cutting over the strips of lead.  
 Fig. 3.—The shell before removal.  
 Fig. 4.—The shell after removal.  
 Fig. 5.—Completed preliminary shell.  
 Fig. 6.—Celluloid jacket for high dorsal tuberculosis of spine.  
 Fig. 7.—Cast for a leg splint.  
 Fig. 8.—Completed splint for quiescent tuberculosis of knee.  
 Fig. 9.—Leg splint showing hinge-straps and buckles.  
 Fig. 10.—Leg splint in use.

PLATE V  
THE PREPARATION AND USES OF CELLULOID SPLINTS : G. E. DUNKERLEY



Fig. 1.



Fig. 2.

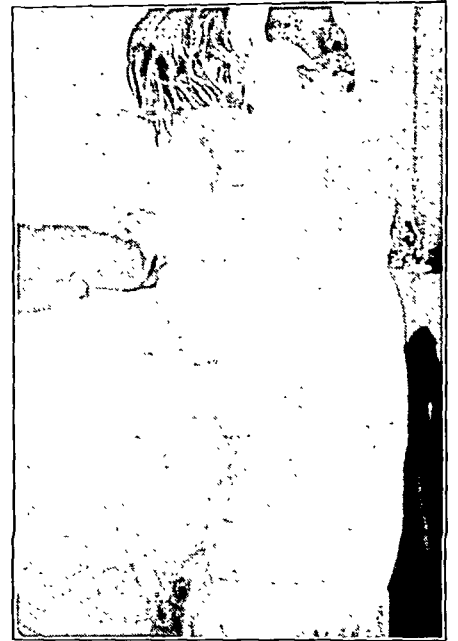


Fig. 3.

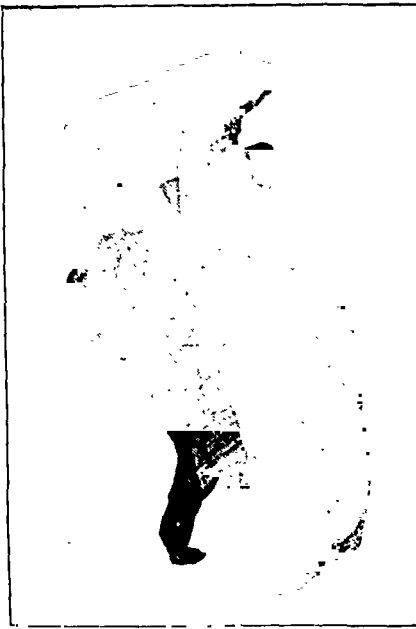


Fig. 4.

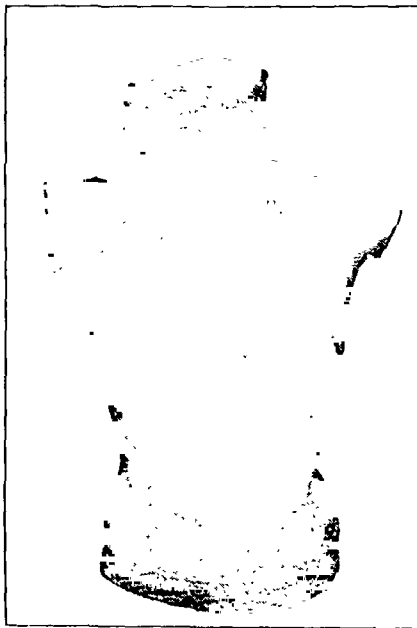


Fig. 5.



Fig. 6.

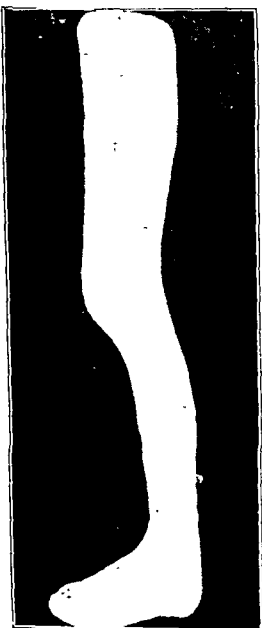


Fig. 7.



Fig. 8.

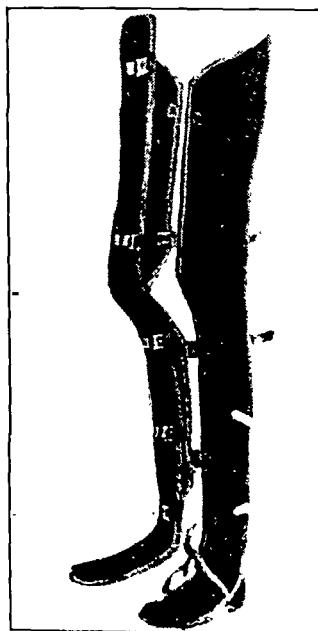


Fig. 9.

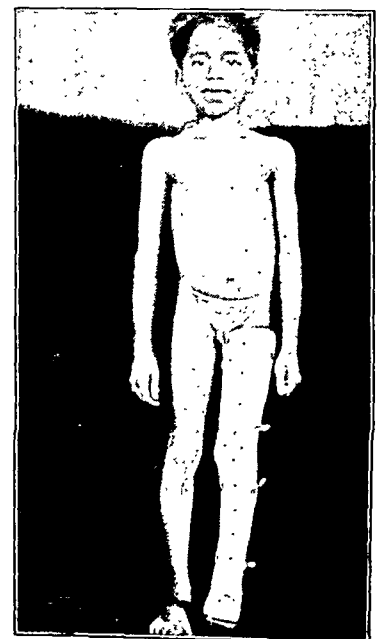
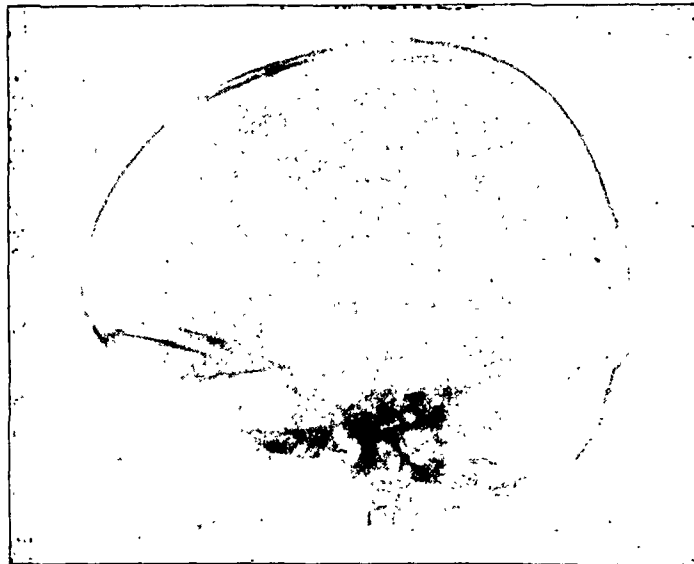


Fig. 10.

PLATE VI  
SIMMONDS' DISEASE : R. VISWANATHAN



Case of Simmonds' disease. Note destruction of clenoid processes, and the round shadow in the sella turcica.

Excretion of water is reduced. Finally, the patient becomes comatose and dies.

Treatment is as a rule unsatisfactory. But successful results with substitution therapy have been reported during recent years.

The case reported below is in all probability one of Simmonds' disease though post-mortem confirmation could not be obtained unfortunately. X-ray findings and the clinical course of the disease however are definitely in favour of the diagnosis.

### Case report

Hindu female, aged 50 years, was admitted into the King George's Hospital on 13th August, 1941, for weakness and loss of weight of two months' duration.

Three years back she suffered for three months from continuous fever of undetermined origin. Administration of a dose of snake venom is supposed to have cured her.

Three months back she developed pain in the right hand spreading gradually to the whole of the right upper extremity. This was followed by slowly developing monoplegia. A month later she developed hiccough and vomiting. Her periods had stopped for five years.

**Condition on admission.**—The patient was in an extremely emaciated condition, lethargic, apathetic, and slow in answering questions. There was no evidence however of any psychic disturbance. Muscular power was weak in the right lower limb and lost almost completely in the right upper limb. There was also slight facial paresis on the right side. Deep reflexes were brisk on the right side. Babinski's sign was positive on the same side. The precordial area of dullness and the area of liver dullness were markedly diminished. Pulse was of low volume and tension, rate being 58 per minute. Blood pressure was 90 systolic and 70 diastolic. There was no sugar or albumin in the urine. Haemoglobin was 70 per cent. Blood: Wassermann was strongly positive.

**C.S.F.**—Wassermann positive, moderate; proteins 35 mgm. per 100 c.cm.; globulin present; Langes's test 002221000.

**Fundus examination report.**—Both discs show signs of optic neuritis. Margins blurred—vessels dilated, tortuous and dark in colour. They are buried here and there by the exudates on the discs. Lamina cribrosa is filled up by exudates.

**X-ray examination.**—Chest: heart narrow and vertical. Liver shadow smaller than normal. Skull: bones thinner than normal. Pituitary fossa larger than normal. Anterior glenoids destroyed. A dense oval shadow seen in the region of the sella turcica confirmed by stereoscopic pictures.

**B.M. rate.**—30 per cent.

### Glucose tolerance test.

|   |    |                    |
|---|----|--------------------|
| Before giving glucose                   | .. | 91.7 mg. per cent. |
| $\frac{1}{2}$ hour after 30 gm. glucose | .. | 184.4 " "          |
| 1 " " " "                               | .. | 212.8 " "          |
| 1½ hours " " "                          | .. | 232.6 " "          |
| 2 " " " "                               | .. | 213.8 " "          |

**Progress.**—Vomiting stopped within a few days after putting her on 5 units of insulin and intravenous glucose, but, in spite of feeding, cachexia became progressively worse. A state of complete prostration developed; urine and stools were passed in the bed though there was no incontinence. The patient was taken home in a moribund condition. Information was received that she died a week later.

**Discussion.**—Progressive extreme emaciation, amenorrhœa, increasing lethargy leading to semi-coma and ending in death, the presence of a shadow in the region of the sella turcica as

(Concluded at foot of next column)

## SULPHONAMIDES IN TOPICAL APPLICATION

By H. J. HAMBURGER, M.D.

Sialkot

THE topical application of sulphonamide compounds is a clinical method of immediate practical importance. A short survey of data from the available literature seems desirable. I am in a position to supplement such survey from my studies on sulphonamides in local use, begun in 1937.

**Literature.**—As compared with the scores of papers on sulphonamides and related compounds as systemic remedies, the topical employment of the drugs occupied only few workers up to 1940. That is understandable, if we recall that originally sulphonamide was designed as treatment against systemic affections, such as, for instance, septicæmia of streptococcal origin. Here, an even distribution of the chemical throughout the infected organism was required. Wherever the bloodstream is carrying the infection, there sulphonamide action is necessary. But there are circumscribed conditions, in which the full concentration of the therapeutic agent is desired on the spot. If the blood supply thereto is insufficient, as indeed the physiology of the diseased body endeavours to arrange around big purulent cavities, in order to protect itself against invasion by the germ, then topical application offers advantages. At any rate, from the outset of clinical employment of sulphonamides their usefulness in this particular way of administration was revealed.

Small sports injuries, cuts, abrasions were treated prophylactically with prontosil by Jaeger (1936). Other earlier papers on the subject have been reviewed by Hamburger

(Continued from previous column)

shown by radiographic examination—low basal metabolic rate and diminished sugar tolerance—are points in favour of a diagnosis of pituitary cachexia which goes by the name of Simmonds' disease. The possibility of Addison's disease is ruled out by the absence of pigmentation.

In this case the atrophy of the anterior pituitary is due to pressure by the tumour as evidenced by the x-ray picture. Owing to the positive Wassermann reaction of the blood and of the C.S.F. and the presence of an upper motor neurone lesion, it is possible that the mass causing the pressure was a gumma.

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(1939, 1940). Old wounds with sluggish granulations, as for instance in Smith's (1940) case, chronic sores treated by Buchanan, varicose ulcers treated by Smith (*loc. cit.*), and Bosse and Bosse (1939) responded well to sulphonamide ointments and dressings soaked in prontosil. Some reports deal with the benefit which deep abscesses, ulcers, purulent cavities derived from instillations and dressings with sulphonamides. Smith (*loc. cit.*) records their use in perineal ulcers and gluteal abscesses. Empyema cavities were filled with sulphonamide solutions after evacuation by rib resection or thoracocentesis. Dey (1940) used urea-sulphazide preparations in 20 cases of minor surgical affections. Childrey (1939) used irrigation with sulphonamide solutions in resistant sinus infection. Good results were claimed for the method in the treatment of various skin affections such as chronic eczema and impetigo. Tramazaygues and Lascalea (1940) treated 35 cases of pyodermatitis with prontosil orally and locally and found response superior to earlier methods. McKenna (1940) was successful in employing the method against ecthyma and impetigo contagiosa. The intrathecal use for the various types of acute meningitis is in a way also a topical treatment. This is now an established clinical method. Dental uses go to filling of root canals with a sulphonamide paste, and packing of tooth sockets after extraction to ensure rapid healing and non-infection. Adams (1940) recommends a 6 per cent hot sulphonamide solution for irrigating abscesses. The solution may be introduced through a root canal into a peri-apical abscess and drained out through the fistula. Many recent papers not mentioned here are reviewed by Hawking (1941).

Recently, a number of reports has come forward assessing the value of the method in war wounds, as required in the earlier mentioned paper. The first paper dealing with sulphonamide packs in recent compound fractures seems to be by Jensen, Johnsrud and Nelson (1939). *The British Medical Journal* of 6th July, 1940, in a leading article on treatment of war wounds, points out again how desirable research is on the question when to apply systemic and when local methods. Levaditi and collaborators (1940) report favourably on the local treatment with rubiazol or sulphonamide of wounds in which infection was already established. The *Journal* tends to favour the prophylactic use in fresh wounds, and to reserve the systemic application to established infections. Casberg (1940) used sulphanilamide implantation as a method of controlling infection in clean surgical wounds. A series of 18 cases of inguinal herniorrhaphies thus treated showed no infections, while two control series show pathogenic organisms in several instances. With 8 grammes of powder, no systemic complications were noted, while 10 to 15 grammes of sulphanilamide caused cyanosis in cases of hip fracture treated by open surgical methods.

At the meeting of the Medical Society of London, 28th October, 1940, a discussion took place on chemotherapy and war wounds. Page (1940) stated that he did not think wounds treated with sulphonilamide packs do much better than others treated under identical conditions without it. On the other hand, the number of cases seen was not sufficient to allow definite assessments. Colebrook (1940) at the same meeting emphasized that old burns and road accidents infected secondarily were cleared up with sulphonamide powder within two days, and the wounds healed more quickly. He asked for more detailed data if bacterial growth was held up in the wounds. He thought that the method, provided that confirmation was forthcoming, would form a landmark in surgery.

The necessary evidence has been forthcoming since last year. Hodgson and McKee (1940) describe how they treated successfully 12 cases of compound fractures or perforating injuries from aerial bombardment, with sulphonamide packings of wounds and bullet tracks. In that stage the authors found it still difficult to gauge the actual effectiveness of the method since other surgical procedures, such as plaster casts and anti-gas-gangrene serum were also employed. However, they observed that infection was definitely less than in parallel cases not treated with sulphonamide, though they believed that infection was not particularly virulent in this series. More impressive was the fact that *Clostridium welchii* infection remained confined to the wound tracks. They put that down, in the light of previous experience, to the local sulphonamide application. In one case of established toxæmia, the combination of sulphonamide and perfringens antitoxin helped to avoid mutilating operations. Toennis (1940) employed with satisfaction, for fresh brain injuries after rational surgical treatment of the wound and reduction of prolapsus through repeated lumbar puncture, a Miculicz tampon soaked in prontosil to keep the wound open.

King (1941) used in the treatment of open war wounds powdered sulfanilamide as wound packing. This was never combined with oral treatment. There were controls with flavin packs, also without oral treatment. Detailed technique of the application is given in the paper, main emphasis being laid on the necessity of introducing the powder into all recesses and corners of the wound, to pack the remaining main cavity with about 20 grammes sulphonamide, avoid suture until about 5 days later when the wound, left untouched until then, shows healthy granulations. Fifteen cases formed group I, which were treated soon after the injury, that is before infection was established. Group II were patients with serious injuries heavily infected, some of them with gas-producing organisms. The author feels entitled to state that the cases thus treated did well, if not better than those treated with flavine packs.

Hawking (1941) undertook a very careful experimental study of the efficacy of local sulphonamides in preventing gas gangrene. Insertion of sulphathiazole into the experimental wounds of guinea-pigs at the same time with the infecting *Cl. welchii*, *Cl. septique* or *Cl. oedematis* saved all the animals. Sulphanilamide and sulphapyridine had more selective power. The author does not propose from the results of his experiments that the use of antitoxin can be dispensed with, but recommends its simultaneous administration. Interesting is also the thorough investigation of the mode of absorption through the tissues surrounding the wound. Robson and Wallace (1941) treated a series of 20 cases of second and third degree burns with a paste containing in a glycerine base about 2½ per cent albucid, 40 per cent kaolin and 5 per cent cod-liver oil (euglamide); the results were equally promising in non-infected and in infected cases. In third degree burns a clean surface suitable for grafting was rapidly obtained. Spink and Paine (1940) were successful in treating 12 cases out of 16 with staphylococcal infections, employing sulphathiazole locally. Hawking together with Piercy (1941) supplemented his previously-mentioned studies with a very valuable investigation on blood concentration of sulphonamide after topical use. Patients with open wounds, compound fractures, suppurating sinuses and various ulcers showed, after local insertion of up to 5 grammes of sulfanilamide or sulphapyridine, rarely above 1.5 mg., usually below 0.5 mg., sulphonamide per 100 c.cm. blood. They conclude that topical treatment can safely be combined with oral doses.

**Practical experiences.**—(1) We have published in this journal (Hamburger, *loc. cit.*) our experiences with two series of 120 cases of Frontier sores and their response to local sulphonamide treatment. The nature of this affection is not quite clear. It is a chronic sore which somewhat resembles clinically cutaneous leishmaniasis, but does not contain leishmania. It may be caused by a virus which is carried by insects. It is usually secondarily infected with a variety of bacteria, as *Streptococcus hæmolyticus*, *Staphylococcus aureus* or *albus*, or Klebs-Löffler bacilli. The biggest group is that infected with one or other of the common pyogenic organisms. They were treated with sulphonamide topically and responded well, in many instances dramatically.

(2) Several cases of impetigo contagiosa were treated successfully with various ointments containing sulphonamides. I cannot say if and in what way this is superior to other treatments, but it is at least as good.

(3) Three cases of persistent varicose ulcers, partially secondarily infected, with a 1 per cent spirituous solution of prontosil responded well.

(4) One case of pneumococcal empyema was cured with instillation of sulphonamide into the pleural cavity.

**Case 1.**—Boy, 7½ years of age. One and a half years ago he had a rib resection. Recovered incompletely, and had fever off and on 3 weeks before admission with daily rises of temperature up to 103°F. X-ray confirmed presence of effusion in the pleural cavity, filling it up to two-thirds of total thorax height. Thoracocentesis performed, evacuation of pus and instillation of 5 c.c. prontosil soluble. Next day suction through the thoracocentesis tube showed that all prontosil had been absorbed. On third day no pus left. Again 5 c.c. were instilled, tube removed, and uneventful recovery followed.

(5) Three cases of extensive infected injuries were treated with topical sulphonamides:

**Case 2.**—A woman had, after a fall off her horse, an extensive sloughing wound over the middle of the front of the left leg. For 3 months prior to admission all other treatments had failed to promote healing. Application of a 5 per cent sulphonamide ointment cleaned the wound, from which streptococcus hæmolyticus had been recovered; within 2 days healthy granulations appeared, and rapid healing occurred.

**Case 3.**—A man had dropped on right middle finger a heavy piece of wood. To stop the resulting hæmorrhage he tied a string tightly around the base of the finger. Four days after the accident he came to the dispensary, with fever and painful and swollen cubital and axillary glands. One-third of the skin of the finger is torn off. The raw surface is heavily infected, the remainder of the finger is blue-yellow, discoloured and cold. A big clot of blood sticks to the finger-tip, at the beginning of putrid dissociation. After cleaning of the wound, septanilam powder made from 1 tablet spread over the whole wound, petrolatum dressing over it. Next day, all signs of ascending infection have disappeared. The wound is cleaner. Three days continued treatment; thereafter rapid healing and complete recovery.

**Case 4.**—A man had had a 3-inch long incision at the outer edge of the sole of the foot, 6 weeks before admission. He had apparently had cellulitis. When seen the incision had failed to close. Two sores of 1 inch diameter had formed at the ends of the old incision. Foul discharge. After cleaning, a 5 per cent sulphanilamide ointment healed the wound within 2 days.

Two cases of chronic paronychia were successfully treated. One had lasted 10 days prior to admission, the other for 6 months intermittently. A 3 per cent sulphonamide-milkan ointment with cod-liver oil was applied, which brought relief from pain within 2 hours. By then, all pus was gone, a gauze strip soaked in spirit could now be pushed easily under the nail bed; the ointment was put on top, and healing followed within 3 and 4 days.

(6) Quite a separate and important item is the treatment of certain eye conditions with topical sulphonamides. For some time the treatment of trachoma with sulphonamides internally has been discussed, but opinions are still divided. We have applied\* sulphonamide to the conjunctiva and, though our studies are not concluded, it seems that patients in the early stages of the affection do well.

For a number of common eye infections, such as impetigo, non-specific granular catarrh of the conjunctiva, phlyctenular conjunctivitis, soluseptasine and soluseptasine ointments have proved a great help. Sanyal (1940) reports similar results with urea-sulphazide. In many instances it was amazing to see how quickly



the worst suppurative conjunctivitis, often with affection of the cornea, cleared up.

*Case 5.*—Boy, 4 years of age. History of 'inflamed eyes' for a week. Routine treatment. In spite of that, deterioration. Both sides acute kerato-conjunctivitis, with severe ciliary injection. Right eye shows pea-sized ulcer at sclero-corneal junction. Five per cent sulphonamide ointment applied. Within 24 hours all subjective symptoms relieved. Inflammation and lachrymation decreased, ulcer has not progressed, and is shallower. Within 3 days, cure; the site of the ulcer can no longer be detected.

*Case 6.*—From the right eye of a 3-year-old girl, a 2½-inch long grass-seed has been removed which had hidden itself in the fold of the lower conjunctival fornix. Parents say that the eye had been bad for 2 months. At any rate the foreign body must have been in for a long time. It had pierced the lower lid from where profuse pus is discharged. Conjunctivitis with ciliary injection. Within 24 hours after 5 per cent sulphonamide ointment application pain and inflammation are gone. The lid abscess has almost closed and is clean.

*Failures.*—There are occasional failures of the treatment discussed here. One case of an extensive phagedænic ulcer covering the whole forearm and one of a less extensive ulcer on the dorsum of the foot did not respond. In the former I had to resort to skin grafting; in the other to curetting.

Trachoma, once advanced beyond a certain stage, does not respond well. It is also useless to treat oriental sores, that is, cutaneous leishmaniasis, with sulphonamides. Berberin sulphate or antimony is called for.

*Dangers.*—The great advantage of the topical sulphonamide treatment is that all risks of toxic reactions, which are involved in its systemic use, are avoided. Hawking's (*loc. cit.*) study about the absorption of the drug from packed wounds is very valuable in this connection. I have seen only one case in which the treatment could possibly have made a patient's condition worse.

*Case 7.*—A man had 3 frontier sores on arm and foot. Three months back he had a smallpox vaccination, the marks of which had not quite healed yet. On both hands he had a chronic eczema; he is a driller in an oil company. Sores responded well to 5 per cent prontosil ointment. He then took without the physician's advice prontosil internally and developed a generalized eczema, which healed only slowly under bland ointments.

It seems necessary to consider the abnormal vaccination, the oral use of prontosil and the occupational factor in explanation of this untoward development.

*Dosage and method of application.*—In my studies on frontier sores, I have used 6 per cent soluseptasine ointment, prontosil soluble 1 to 5 per cent and prontosil base ointment 5 per cent with equally good results. In all other cases I used soluseptasine soluble or septanilam tablets powdered. These were either applied as powder or, after crushing, incorporated into glycerin for paints or into petrolatum for ointments. A little alcohol and acetone help to dissolve tablets. I have also used an ointment which is commercially available containing 5 per cent sulphonamide and cod-liver oil,

together with a milk protein (Milkan). This was also very useful. For ophthalmic purposes it is imperative to use a good ointment base like finest Gainsborough vaseline or anhydric lanoline. Usually 1 per cent is sufficient. Higher concentrations tend to provoke irritation. The vehicle must always be bland. If nothing else is available the contents of ampoules can be used though that is not very economical. For empyema and application to other closed cavities the ampoules are very helpful. Into the cavities of big compound fractures the powder or powdered tablets should be packed. Here any oily or fatty vehicle must be avoided, for obvious reasons.

From the intact surface of the skin and from small chronic areas practically no absorption into the system takes place. Hawking's studies (*loc. cit.*) are based on the incorporation of not more than 5 grammes of the drug. With that blood concentration remains far below the danger level. I would hesitate to employ more than 10 to 15 grammes, especially if concurrent, oral or parenteral treatment might still be needed.

### Summary

The recent literature and actual practical experiences on the topical application of sulphonamides are surveyed. The method has been found a great help in minor and major circumscribed septic conditions of about 140 cases. It is considered superior to systemic application in such cases where a high concentration of the therapeutic agent at the site of the lesion can otherwise not be achieved.

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## NOTE ON 'TROPICAL ULCER' IN COORG

By M. S. BOPAIYA, L.M.F.\*

and

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In the course of nutritional investigations in Coorg (Bhave and Bopaiya, 1942), it was observed that numerous cases of chronic ulcer of the skin and underlying tissues, usually situated on the legs, were under treatment in local hospitals. This condition appeared to be identical with 'tropical ulcer', 'tropical sloughing phagedæna' or 'Naga sore', as described in textbooks of tropical medicine. Some observations with regard to incidence were made and a pathological examination of sections of ulcer obtained by biopsy was undertaken. While these investigations have not thrown any new light on the ætiology of the condition, it is thought worth while to place them on record. The prevalence of tropical ulcer in Coorg has not hitherto been recorded in the literature.

Coorg is a small province with an area of 1,593 square miles and a population (1931 census) of 163,000. It has a heavy annual rainfall of about 120 inches. In general the province is mountainous, with abundant forest and jungle. Rice is cultivated in the valleys. The chief commercial crop is coffee.

*Clinical description.*—The ulcers as seen in patients applying for hospital treatment are usually roughly circular in shape, and their size varies from 1 to 4 inches in diameter. The usual location is the anterior surface of the lower third of the leg and the ankle. When the patient is admitted into hospital the ulcer is often in a septic and sloughing condition; the edges are sharply-cut and undermined, and show no sign of healing; the base is covered with an ashen-grey slough and there is an abundant offensive discharge; the surrounding skin is red, œdematous and painful. Chronic or indolent ulcers are often seen. In this case the ulcer is usually of long duration and there may be healing at one side while the cicatrix at the other has broken down to form a new ulcer. The healing stage presents the usual features:—raised smooth edges, healthy granulation tissue and relative absence of discharge.

Most cases give a history that the ulcer started after slight or moderate trauma. The general condition is poor, most patients being anæmic as the result of coincident or pre-existing malaria

and ancylostomiasis. Signs of malnutrition, e.g., phrynoderma, are often present.

*Incidence*

The following table shows the percentage of coolies and non-coolies among 200 cases admitted into the civil hospitals in Mercara and Virajpet, respectively, during the years 1938–41. The sex incidence is also shown.

TABLE

*Proportion of coolies and males among 400 cases of tropical ulcer*

|   | Civil Hospital,<br>Mercara<br>(200 cases) | Civil Hospital,<br>Virajpet<br>(200 cases) |
|---|---|--|
| Number of coolies ..                      | 120                                       | 92   |
| Per cent ..                               | 60.0                                      | 46.0                                       |
| Number of non-coolies ..                  | 80  | 108  |
| Per cent ..                               | 40.0                                      | 54.0                                       |
| Per cent of coolies among all admissions. | 36.6                                      | 29.0                                       |
| Per cent of males among all ulcer cases.  | 83.0                                      | 81.0                                       |
| Per cent of males among all admissions.   | 60.1                                      | 63.8                                       |

There was a definite preponderance of cases among coolies as compared with other classes admitted into the two hospitals in question; this was more marked in the Mercara hospital group. In Coorg 'coolies' are mainly labourers on coffee estates. Of other admissions into hospital, the majority were ryots cultivating their own land, with a smaller number of townspeople. Males are more liable to attack than females. As regards the age incidence, 59 and 73 per cent in the Mercara and Virajpet hospital groups respectively were between the ages of 20 and 40.

Cases were admitted into hospital at all seasons. There is, however, some tendency for more admissions to take place during the first half of the year. Of the 200 Mercara cases, 121 (60.5 per cent) were admitted during the months of January to June and in the Virajpet group 42 per cent were admitted in May and June. About 4 per cent of all admissions were ulcer cases and usually a prolonged stay in hospital is required. The condition is thus of considerable public-health importance.

*Pathological findings*

The histological appearances of the ulcer vary with its clinical condition. In acute cases, the superficial layer of the ulcer consists of necrotic tissue in which collections of red blood cells and polymorphonuclear leucocytes are seen. Evidence of coagulation-necrosis, with an increase in the number of polymorphonuclears, is seen underneath this layer. The fibroblasts in the deeper layers are increased. In subacute and chronic cases, the base of the ulcer shows vascular granulation tissue. At the margin of the

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ulcer, the epidermis shows hyperplasia, and the edges are undermined.

Scrapings from the surface of the ulcer show in most cases numbers of darkly-staining fusiform bacilli and fine spirochaetes (*Treponema vincenti*). The fusiform bacilli are mostly present in the superficial parts of the ulcer below the necrotic tissue, whereas the spirochaetes are seen both at the base and edges of the ulcer.

Other organisms, e.g., diplococci, streptococci, and bacilli, are also in evidence.

These appearances closely resemble the description of tropical ulcer given by Roy (1939), Rogers and Megaw (1939), and others.

Smears made from the material aspirated from the base of the ulcer (by puncturing the healthy skin surrounding the ulcer and pushing the needle beneath the base of the ulcer) were negative for *Leishmania tropica*.

#### Discussion

A considerable literature about tropical ulcer is already in existence. In India it has been given the greatest attention in Assam, where it is usually known as 'Naga sore'. In a previous paper from these laboratories about diet and anaemia in Coorg (Bhave and Bopaiya, *loc. cit.*), the similarity of conditions in Coorg and Assam was pointed out. In both areas there is a large coolie population, employed on tea plantations in Assam and coffee plantations in Coorg. In both areas malaria, hookworm and anaemia are prevalent and there is much malnutrition. It is interesting and significant that a high incidence of tropical ulcer should exist in both places.

The view that the factor of malnutrition is of importance in the causation of tropical ulcer has been put forward by various workers (McCulloch, 1928; Brown, 1935; Clements, 1936; James, 1938; Corkill, 1939). No direct proof of the relationship has, however, as yet been forthcoming. The present investigation throws little further light on the problem. It is, however, worth pointing out that tropical ulcer is relatively rare in tea plantation labourers in the Nilgiri hills. The diets consumed by coolies in this area are as defective as those consumed by coolies in Coorg and Assam (Wilson and Mitra, 1938; Krishnan, 1939; Bhave and Bopaiya, *loc. cit.*, in press). Malaria, hookworm and severe anaemia are rare in the Nilgiris. It thus appears probable that other factors besides malnutrition must be operative in areas in which the incidence of tropical ulcer is high. Presumably these include anaemia and debility resulting from blood-destroying diseases.

#### Summary

(1) Tropical ulcer is common in Coorg. The greatest incidence is among coolies on coffee plantations.

(2) A histopathological description is included and the relation of the condition to malnutrition is briefly discussed.

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## PELLAGRA IN THE UNITED PROVINCES

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A REVIEW of literature appearing in the *Indian Medical Gazette* on this subject for last 12 years 1928-40 shows that, apart from 40 cases reported in 1931 and 30 cases in 1933 by Lowe from Dichpalli, Hyderabad (Deccan), there are only 34 cases more reported from different parts of India and one from Burma. Out of the 34 cases 12 were seen in Southern India (Guntur 4, Vizagapatam 8), one in Poona, 16 in the Punjab (Lahore 1, Kangra District 15) and 5 in Calcutta. Napier (1939) reports that they encounter 6 to 12 cases a year in the outdoor clinic of the Calcutta School of Tropical Medicine. No cases have yet been reported from the North West Frontier, Sind, Baluchistan, Rajputana, Central India, the Central Provinces, Assam, Bihar and the United Provinces.

Pellagra is probably not at all an uncommon affection in those provinces, but it is generally not diagnosed there. It is, in its typical form, so easily diagnosed and with the advent of nicotinic acid so quickly controllable a disease that it is a pity that pellagrins are allowed to suffer for years, only for want of correct diagnosis. One of my cases suffered for four years and in desperation was ready to resign his service twice, and in the end was given up as a hopeless case, when a correct diagnosis put him on to his feet in 20 days, enabled him to regain 42 lbs. in weight, and he returned to work in two months. Napier rightly remarks that if the medical officers would be on the lookout they would often find such cases in

(Continued from previous column)

#### Acknowledgments

This investigation was supported by the Indian Research Fund Association.

The help of Captain G. L. Charlewood, I.M.S., Civil Surgeon, Coorg, and Dr. P. D. Bhave in collecting hospital statistics is gratefully acknowledged.

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their daily practice. I have encountered six definite cases of pellagra and many more of nicotinic-acid deficiency during my 18 months' stay—December 1938 to June 1940—in the United Provinces. Two cases were seen at Tundla (Agra, 1938), one at Allahabad (1939), two at Moradabad (1940) and one at Cawnpore and Mussoorie (1940).

Three typical cases\* are described below:—

*Case 1.*—A shoe-merchant of Agra, aged 40 years, had very dry skin, cracked lips and severe constipation. He went to Karachi on business in November 1926 and found within a few days dark pigmented patches on his nose, cheeks, chest, back of hands and forearms and on extensor surfaces of legs which became scaly and cracked. He also felt very weak, lost weight and complained of severe indigestion and flatulence. He continued suffering and was diagnosed as lichen planus, dermal leishmaniasis and Addison's disease at various times. He consulted me at Tundla in December 1938. He was, then, very weak, morose, depressed and his skin very thick, black and scaly. The distribution of pigmentation though extensive was definitely symmetrical. I thought of pellagra and treated him with diet of high caloric value giving him meat, eggs, fish, milk, marmite and a cup of raw liver juice after meals. Nicotinic acid was not available. His general condition improved rapidly and his skin condition also changed by the end of January 1939. He continued treatment and changed his monotonous diet of beef curry and wheat chapaties to varied items of food. The next season he remained well and his skin also did not become black as it had done for the last 12 years.

*Case 2.*—A fair-skinned lady of Agra, aged 22 years, had rough, scaly, dark, pigmented patches on the tip of her nose and cheeks. She also had enlarged cervical and abdominal lymph glands and occasional attacks of indigestion and diarrhoea. Her usual diet was a mixed one of wheat chapaties, *dāl*, vegetables and beef. She had no inclination to eat fruits, eggs and milk. Her attending physician suspected her of suffering from intestinal tuberculosis and lupus on the face. She was brought to me at Tundla in December 1933 for ultra-violet therapy. I gave her a tonic course of ultra-violet and 30 injections of calcium with vitamin D (Glaxo) and a rich nourishing diet. She rapidly improved under treatment and the patches on her face became smooth and lighter in shade but did not altogether disappear. A recurrence occurred and she saw me again in November 1938. She, then, had typical skin pigmentation on the face, hands and forearms, below the scapular regions and eczematous patches on the dorsum of both feet. She was weak, irritable and hysterical. Her diarrhoea and indigestion were very troublesome and she had amenorrhoea as well. Her blood pressure was low, 95/60. She was a complete picture of *tabes mesenterica* except that the skin condition was not there. I treated her as pellagra. Nicotinic acid was not available. Medicinal yeast, 60 grains a day, and virol were added to a rich diet which she took for months. The improvement was rapid and when I saw her after a time she was in perfect health though I noticed faint reddish patches on her face and roughness of skin on the dorsum of her feet.

*Case 3.*—A 36-year-old man of Allahabad district, working as 'beldar' and living on a diet of wheat-atta, *dāl* and vegetables had symmetrical and pigmented erythematous patches on the exposed parts of legs, hands and face. He had spastic paresis with stiffness and loss of power of the lower extremities causing difficulty in walking. His knee-jerks were exaggerated. His tongue was flabby showing indentations of teeth laterally but he had no dyspepsia or any other symptoms of gastro-intestinal disturbance. Gastric analysis showed achlorhydria. Total leucocytes 6,000, red cells 3,005,000, hæmoglobin 65 per cent and colour index 1.1.

Urine showed traces of albumin. He was first suspected of syphilis of the nervous system and later of leprosy. I saw the case on 27th June, 1939, and diagnosed it as pellagra with associated conditions of vitamin B<sub>1</sub> deficiency.

*Treatment.*—He was admitted to the railway hospital, Allahabad, and was treated with high protein diet and 5 oz. of wheat germ a day. Iron and arsenic were administered by mouth and liver extract by injection. Nicotinic acid was not available locally. I left Allahabad on 12th July, 1939, and my colleague later on informed me that the paresis and the skin lesions disappeared, his blood picture and hæmoglobin value came up to normal, and he was discharged as fit in a month's time. His case could only be followed for 6 months, i.e., up to January 1940, and in spite of the winter season no relapse of the pellagra symptoms was noticed. He then left the service. The peculiarity of the case is the predominance of nervous symptoms and later on the persisting erythematous condition of skin very closely resembling leprosy, and the absence of practically all gastro-intestinal symptoms to the extent that even the loss of appetite was not complained of by the patient though achlorhydria was present.

#### *Review of the known facts regarding pellagra*

*Ætiology.*—It is now well established that pellagra is associated with nicotinic-acid deficiency. The exact ætiology is, however, not yet clearly understood, and certain attractive hypotheses have failed to stand the test of authentic observations recently made in this connection by various workers.

*Association of maize with pellagra.*—Chick (1933), reviewing the dietetic theories, mentions that one of the established facts about pellagra is that it is invariably associated with the use of maize as a staple cereal in diet, but in all my cases there is no history of any maize-eating even as a change of diet by choice or necessity. Three cases of Raman (1933) were not on maize diet. Castellani and Chalmers, writing as far back as 1913, record that 'persons who are alleged never to have tasted maize have suffered from pellagra' and Napier (1939) authoritatively asserts that pellagra does occur in non-maize-eating people. The claim, therefore, that pellagra is invariably associated with maize diet is, now, no more tenable.

*Theories of maize and other food toxins.*—Heatley-Spencer and Biggam (1938) mention that 'it is highly probable that the correct hypothesis is that advanced by Chick', namely, that pellagra is caused by a toxic substance derived from maize, or occasionally from other cereals, which can be corrected by sufficient good protein or perhaps by sufficient vitamin B<sub>2</sub>, found to accompany good protein; but as non-maize-eaters do get pellagra, any theory that assumes invariable association of maize with pellagra should not hold good. However, there still remain George Mauriquand's observations that there are certain substances called 'dieto-toxin' which remain without toxicity under normal conditions, but reveal it when diet becomes deficient or ill-balanced. Viewed in this perspective the food toxin theory becomes very attractive. The association of peripheral neuritis with pellagra also lends support to it but the advent

\* Full notes on other three cases omitted in interest of space.—Editor, I. M. G.

of nicotinic acid has proved that neuritis and similar troubles are associated conditions which do not belong to the pellagra syndrome and are corrected by vitamin B<sub>1</sub>, showing their origin in a deficiency rather than in a toxin. The food toxin theories including Chick's hypothesis have also no sufficient clinical or experimental support and therefore do not stand on very solid ground.

*Theories of protein deficiency.*—These theories assume that lack of protein of high biological value or deficiency in diet of certain amino-acids causes pellagra. In my cases all of them except one used animal proteins. Case 4 had plenty of good proteins and case 6 had milk and eggs. Still they got pellagra. Moreover, nicotinic acid is giving marvellous results even in those cases who continue eating pellagra-producing diet. It, therefore, appears that the deficiency of protein of ordinary or specific variety is not the main causative factor, but as suggested by Napier (1939) a monotonous diet like that of my case 1, who ate nothing but bread and beef curry for years, or rich and varied but insufficient diet of my case 6, or medically restricted diet like that of case 5, are the important factors in producing the symptoms and keeping them up indefinitely until suitably corrected.

*Castle's theory of anti-anæmic factor deficiency,* as in sprue and pernicious anæmia. Cases of hyperchromic anæmia in pellagrins are recorded. It has also been noted that no improvement in the red cell occurs without liver-therapy (Gupta, 1935), but in my case 4, during the last stages of the disease, though hyperchromic anæmia was present, intensive liver therapy made no impression whatever but response was immediate to nicotinic-acid therapy. Observations like this show that Castle's theory does not fit the picture.

*History of vitamin deficiency.*—Goldberger cured pellagrins by administering yeast to them and found that vitamin B contains a heat-resisting water-soluble pellagra-preventing substance (P. P. factor) which was named B<sub>2</sub> in Europe and vitamin G in America. Later on it was found that the vitamin B<sub>2</sub> complex contains nicotinic acid, lactoflavine, and B<sub>6</sub> antidermatitis factor. Now, when nicotinic acid is synthetically prepared and clinically used it is the same thing as the P. P. factor of Goldberger and it definitely cures pellagra.

Pellagra appears to be a definite clinical manifestation of nicotinic-acid deficiency which may be produced in the body by a variety of causes and not necessarily by a single definite cause. The syndrome may, thus, manifest itself at any stage of certain exhausting diseases or food deficiency states or as a separate entity resembling a definite disease whenever a severe or complete depletion of nicotinic acid happens to occur in the system due to a pure and simple deficiency, almost in the same way as rickets manifests itself whenever there is a deficiency

of vitamin D in the body through any cause whatever.

*Age and pellagra.*—Pellagra was considered to be an adult disease. The lowest age in Lowe's series of 70 cases in 1931 and 1933 was 14 years. Mitchell, as quoted by Chick, also observed that it was a disease of adults and in that respect differed from other nutritional diseases of children. The above observations are, however, not correct. Napier (1939) mentions that it may occur in patients aged 3 months to 100 years. The youngest patient of mine was 5 years of age. I find that nicotinic-acid deficiency is a very common factor in Indian children belonging even to middle and high-class families. In one building situated on a high hill in Happy Valley region at Mussoorie where 14 middle-class families lived in flats, I saw more than a dozen children who within few days of coming up from plains to the hills got erythematous patches, which later on became scaly and pigmented and were situated especially on the fingers, dorsum of the hands and forearms, the tip of the nose, malar regions of cheeks, and, in cases where the legs were kept exposed, on the extensor surface of legs. I first took the patches to be due to solar dermatitis; I wanted to be sure. I took two such cases and to one I gave pellagra treatment and to the other various ointments for skin lesions. The first child was cured without local application within a week while the other continued to suffer for a month. On inquiry, I have also been informed that such dermal lesions at Mussoorie are known to resist all skin lotions and ointments applied locally. My conclusions, therefore, are that pellagra is not confined to adults but may occur at any age and that children in India very commonly suffer from grave nicotinic-acid deficiency which remains undiagnosed, because they generally do not show the skin lesions in the plains, unless exposed to a very dry and cool air and bright sun rays rich in ultra-violet radiations such as are found in Mussoorie in May and June.

*Social status and pellagra.*—Chick calls it a disease of the poor, but I find that it also attacks the ignorant rich and those middle-class people whose diet remains unsuitable or restricted for any length of time.

#### *Clinical course*

*Onset.*—It is generally gradual, afebrile and without grave constitutional disturbances if the gastro-intestinal or nervous system is not involved from the very first. Three cases of mine remained afebrile all through. Case 1 having seasonal dermatitis, had no other troubles for years. Case 5, in spite of skin and mental conditions, continued working for a year until diagnosed, but case 4 starting with gastro-intestinal involvement had so severe an onset that it was taken to be cholera, and case 3, with nervous affection, was crippled from the very start.

*Comparative involvement of various systems of body.*—There are four particular systems;

*viz*, cutaneous (skin), gastro-intestinal (mucous membrane), nervous, and circulatory that are generally involved.

*Skin lesions.*—They are the most characteristic feature of the disease. In 4 out of my 6 cases skin lesions were first to appear or probably first to be noted. Rau and Raman's observation is the same. Lowe held the same view in 1931 but remarked in 1933 that glossitis may be the first symptom to appear. However, skin lesions are so characteristic that a definite diagnosis of pellagra is very difficult in their absence. I have been very fortunate to have come across practically every sort of skin lesions and in all their stages. One of my cases had 'butterfly patch' on his face. The dark 'collar patch' on the neck which is generally so very marked and striking was also observed by me from the very date of its appearance until the day of its disappearance under treatment. The initial and successive stages of the skin lesions were noted by me in case 6 as thickened, angry-looking, erythematous patches on the skin between the fingers. The erythema disappeared within three days leaving a dry, scaly, dark-brown patch with a minute raw surface in the centre, while in case 5 similar patches which were a year old were found to be thick, rough, black and having a scaly core in place of the raw centre noted in the initial stages of the other case.

*Causation of the skin lesion.*—A dry and cool season and strong sun-rays are definitely the exciting causes, but whether sun-rays activate a pre-toxin or merely act as a trauma, or whether it is the presence in the blood of a toxin of dioxy-phenylalanine type (dopa) which resembles tyrosine that gives the skin pigmentation is not yet definitely settled. However, I think that 'effect of sun is purely a matter of trauma' (Stannus, 1937). My observations show that a destructive dose of ultra-violet rays gives pigmentation of the skin only in a person with nicotinic-acid deficiency and even then only when the skin is prepared for it by a dry and cool season, and, as Lowe (1933) points out, when there is marked difference between day and night and sun and shade temperatures which make the exposed part of the skin dry and liable to cracks.

In one of my cases there was evidence that the rubbing of the shoes had caused the pellagrous dermatitis.

*Gastro-intestinal lesions.*—Lesions of the mucous membrane, when they do occur, are generally not of the ulcerative but of the atrophic type. They are followed by grave constitutional disturbance. In one case the disease started with diarrhoea and vomiting; he suffered for a year and was almost dying when recurrence occurred.

Case 2 had skin lesions in the beginning but, when diarrhoea started, her health was so much disturbed that she looked a picture of advanced *tabes mesenterica*. However, diarrhoea is not a common complication and occurs only when the

disease attacks in a severe form. Three cases out of the six had constipation, loss of appetite, vague abdominal pains and troublesome gases in the intestines, but never diarrhoea. The lesions of the tongue and fauces are also not always present. Lowe (1931) noted such lesions in only 50 per cent of his cases.

*Lesions of the nervous system.*—Nervous lesions in pellagrins do not all belong to the pellagra syndrome. Peripheral neuritis and involvement of the cord, such as was present in case 3, are associated conditions and are often due to vitamin-B<sub>1</sub> deficiency. 'Mental conditions' like the depression almost melancholic in nature which made my case 4 resign his service twice and despair of his final recovery, or the suicidal tendency which my case 5 had, definitely come under pellagra syndrome and are very easily cured by nicotinic-acid therapy. Lowe recorded a case of pellagra (1931) who became so 'mental' that he actually committed suicide by drowning. Cleckley, Sydenstricker and Geeslin (1939) treated with nicotinic acid 19 cases of a typical psychotic state with malnutrition in elderly patients suffering from arterio-sclerosis and other chronic diseases, with great improvement in 4 cases and dramatic 'cure' (of psychotic state and glossitis) in the rest. The presenting symptoms were those of chronic diseases *plus* 'hebetude to profound stupor' and in 4 cases glossitis, but dermatitis and gastro-intestinal symptoms were not present. They came to the conclusion that 'many patients are allowed to die because of failure to recognize the cerebral symptoms of pellagra when other evidences of the disease are absent' and that 'a therapeutic test with nicotinic acid is justified in unexplained cases of hebetude or unconsciousness'. They also agree with the suggestion of Jolliffe that cerebral manifestations may be the first evidence of severe or complete depletion of nicotinic acid.

*Circulatory lesions.*—Myocarditis and degeneration of heart-muscle in pellagra cases have been recorded but I am not sure whether pellagra is responsible for the troubles or the gradual heart failure is due to prolonged suffering and continued severe illness. I noted in my case 4 that the cedema of feet and hands, dyspnoea, rapid and weak pulse and the blood pressure as low as 92 systolic and 59 diastolic, all suddenly improved to normal within 20 days of beginning nicotinic-acid treatment. I wonder how one could explain such a rapid and dramatic recovery of a failing heart if we persuade ourselves to assume that it was solely damaged by prolonged and severe illness and not directly by nicotinic-acid deficiency.

*Diagnosis.*—Skin lesions in my cases were mistaken for simple dermatitis, lichen planus, dermal leishmaniasis, Addison's disease, lupus, leprosy, eczema, syphilitic pigmentation, spider lick, scabies and solar dermatitis. Gastro-intestinal conditions were wrongly diagnosed as tuberculosis of intestine, hill diarrhoea, cholera,



chronic dysentery, sprue, colitis, dyspepsia, gastric ulcer and deranged liver. The mental states were taken to be due to anxiety and worry, hysteria, syphilis of the nervous system, nerve-leprosy, depression and despair due to prolonged illness, over sensitiveness, neurasthenia, melancholia, malingering and mental backwardness in the child. The above mistakes made by very highly qualified and experienced doctors should be enough to show that pellagra can be diagnosed only if we always keep its existence and its definite manifestations in mind when dealing with our cases of skin, gastro-intestinal tract and vague nervous and mental conditions in places with a cool and dry season and plenty of strong sunshine.

**Laboratory findings.**—These do not help much in the diagnosis except that achlorhydria is frequently found. Stools and urine show nothing except that when diarrhoea is present it is of lenteric type with non-fatty stools. Urine test for porphyrin was not done in my cases and I believe is not of much help in clinching the diagnosis. Hypotension is common. Total leucocyte count is generally normal, total red cells below normal and hæmoglobin value may or may not be very low. Hypochromic anæmia is believed to be commonly present but cases with megalocytic hyperchromic anæmia, including two of my own cases, are recorded. The latter type so closely resemble pernicious anæmia that one can be very easily mistaken for the other, if the characteristic skin lesions of pellagra are not present or not carefully noted and the therapeutic test with nicotinic acid is not tried in very doubtful cases. Wilkinson (1936) goes so far as to say that 'it is highly probable that in the more tropical zones cases of what is essentially pernicious anæmia may so closely resemble sprue or pellagra as to be so diagnosed according to local bias'. As cases of true pernicious anæmia are almost unknown in India, Wilkinson's remarks could be reversed and we may say that no case should be diagnosed as pernicious anæmia unless pellagra is definitely excluded. Apart from characteristic skin lesions and a favourable history the only sure test for pellagra available to us is the therapeutic test with nicotinic acid, which has assumed such an importance that if a suspected condition gives no response to the test it may be taken to be due to anything but pellagra.

**Prognosis.**—In India, Lowe had a mortality of 50 per cent in his cases with mucous membrane involvement in 1931. He also thought that most mental cases end fatally. In 1933, when 60 grains of yeast and half a pound of meat a day was added to the dietary of his patients the death rate became *nil*. The introduction of nicotinic acid has now made the prognosis invariably good. My case, 4, who was in the terminal stage of the disease recovered so rapidly that I now believe that if nicotinic acid is available no case of pellagra should ever be declared as hopeless, in whatever condition he may be.

**Treatment.**—I find that when nicotinic acid is not available, cases of pellagra can very successfully be treated if 60 grains of yeast, 5 ounces of wheat germ, and a cupful of raw liver juice, or two cups of liver soup, prepared without addition of water in a steam cooker, are added to a daily liberal mixed diet and iron and arsenic given when needed. I treated the first three of my cases on the above lines. The results were rapid and good. The skin condition of case 1 did not clear altogether. The last three cases received nicotinic acid as well. The results were dramatic. As for doses, case 1 got 500 mg. a day by mouth for 10 days, 200 mg. for another 10 days, 100 mg. for two days in a week for about 2 months, and is now having 100 mg. for 2 or 3 days once a fortnight, as a maintenance dose. To combat anæmia, weakness and loss of appetite during convalescence I find caldeferrum (Glaxo), two tablets immediately after meals, an excellent iron tonic. Liver injections are essential for cases with hyperchromic anæmia and vitamin B<sub>1</sub> for actual neuritis, paresis and similar associated conditions. Anti-diarrhoea mixtures and powders usually do not control diarrhoea of pellagrins, and when they do they produce sickness, distension, heaviness and uneasy feeling in the abdomen. I find that one or two teaspoonfuls of ispaghul mixed in a small quantity of curd (*dahi*), swallowed without chewing, prevents diarrhoea without causing any inconvenience. The residual diarrhoea persisting for 2 months after nicotinic-acid treatment in one case did not yield even to opium but did so to ispaghul in two days.

**Sodium thiosulphate.**—Sabry in Egypt got good results by intravenous injection of sodium thiosulphate in pellagra cases. He thought the drug neutralized the maize-toxin which circulates in the blood of pellagrins. Lewis (1938) reported that he cured a case in Burma by giving 10 c.cm. of 10 per cent sodium thiosulphate intravenously twice a week. He gave no other treatment to his case. Rau and Raman (1936) found that protein diet and liver soup gave invariably good and rapid results, whether sodium thiosulphate was given or not. Napier (1939) recommends its use for rapidly clearing the skin lesions in pellagra. I have no experience of it and find no records to show that dermatitis of pellagrins could rapidly be cleared by injection of sodium thiosulphate. However, as the skin condition, especially when in a chronic state, does not altogether clear for months after even combined nicotinic-acid and B<sub>1</sub> and B<sub>2</sub> treatment, sodium thiosulphate deserves a trial.

My thanks are due to Dr. F. E. R. Laborda, the Chief Medical Officer, East Indian Railway, for permitting me to submit this paper for publication. I have also to thank my colleagues, Dr. S. N. Lahiri, D. M. O., Allahabad, for sending me the follow-up notes of case 3 and Dr. B. G. Kane, D. M. O., Moradabad, who supervised the treatment of cases 4 and 5.

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## A NOTE ON EVE'S HALOMETER

By PRAN NATH CHUTTANI, M.B., B.S. (Punjab),  
D.T.M. (Cal.)

RECENT inquiries have shown that a large number of important medical teaching institutions in India are still using the Eve's halometer for measuring the red cell diameter. Outside India also, the instrument continues to be treated with respect by some workers (Beaumont and Dodds, 1941). The observations recorded in this paper were made during the course of an inquiry into anæmias at the Mayo Hospital, Lahore, in 1939. In thirty-one cases the average red cell diameter was estimated both by Eve's halometer and Price-Jones' method from blood smears taken at the same puncture. Halometric observations were carried out on the same day on dried, unstained and properly-made blood films, but the Price-Jones curves were drawn from the preserved Giemsa-stained films about a year later at the School of Tropical Medicine, Calcutta. The thirty-one double diameter observations and the corresponding mean corpuscular hæmoglobin values have been tabulated.

The value of correlation between the Price-Jones and the halometric readings (*see* table) works out to 0.1979, which has no statistical significance. Accordingly either one or both the instruments are definitely biased. The

means of the two series are also significantly\* different from each other at even one per cent value.

TABLE

| Mean diameter of 500 red cells as obtained by the Price-Jones method | Mean diameter obtained by Eve's halometer | Mean corpuscular hæmoglobin values |
|--|---|------------------------------------|
| μ  | μ   | γγ                                 |
| 6.73   | 8.00                                      | 30.78                              |
| 7.16   | 8.10                                      | 26.36                              |
| 7.50   | 8.00                                      | 29.39                              |
| 7.64   | 7.40                                      | 29.31                              |
| 6.88   | 8.19                                      | 28.50                              |
| 7.41   | 8.00                                      | 20.11                              |
| 6.74   | 7.80                                      | 20.52                              |
| 6.87   | 8.40                                      | 25.65                              |
| 6.45   | 7.90                                      | 21.60                              |
| 5.85   | 7.65                                      | 23.67                              |
| 6.45   | 7.65                                      | 22.44                              |
| 7.21   | 7.90                                      | 11.80                              |
| 7.24   | 7.80                                      | 22.50                              |
| 6.92   | 7.90                                      | 20.31                              |
| 8.12   | 8.44                                      | 40.18                              |
| 8.27   | 7.70                                      | 40.18                              |
| 9.06   | 8.20                                      | 43.06                              |
| 8.06   | 8.60                                      | 39.79                              |
| 8.03   | 8.39                                      | 46.63                              |
| 8.22   | 8.20                                      | 46.03                              |
| 8.00   | 8.00                                      | 38.30                              |
| 8.40   | 7.80                                      | 34.20                              |
| 8.06   | 7.80                                      | 53.10                              |
| 7.37   | 7.70                                      | 34.94                              |
| 7.66   | 8.40                                      | 20.72                              |
| 7.42   | 8.40                                      | 20.30                              |
| 7.21   | 8.20                                      | 27.48                              |
| 7.40   | 7.80                                      | 34.20                              |
| 7.86   | 7.00                                      | 33.34                              |
| 8.29   | 8.20                                      | 39.97                              |
| 7.85   | 7.90                                      | 36.39                              |
| Average mean.  | 7.98                                      | 31.02                              |

(Continued from previous page)

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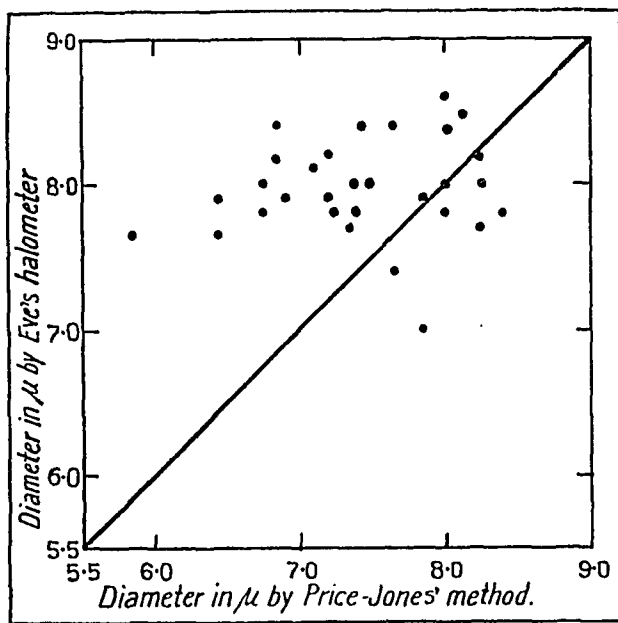
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The figure drawn to bring out sympathetic growth, if any, between the two methods also shows a complete lack of relationship. Adopting the standards of Price-Jones for macrocytosis and microcytosis we find that according to the halometer twenty-five cases are definitely macrocytic, four are suspiciously macrocytic and only two are normocytic. (It may be noted here that in this investigation selection of halometrically macrocytic cases was deliberate.) According to observations taken by the Price-Jones method, on the other hand, it is found that only twelve cases are definitely macrocytic, two suspiciously macrocytic, twelve normocytic, three definitely microcytic, and two suspiciously microcytic.

The macrocytic cases by the Price-Jones method appeared to bear greater correlation to the corresponding halometric observations than

\* Unqualified significance means significance of 5 per cent value.

did the normocytic or the microcytic cases. To subject this impression to statistical analysis the Price-Jones observations were split up into two groups, macrocytic (suspicious and definite) and non-macrocytic, and the correlation values with the respective halometric readings were calculated again. The correlation values in both the groups were not significant.



That the method of Price-Jones is the most accurate means of measuring the red cell diameter is an established fact and the above figures, with this background, speak for themselves and show that Eve's halometer is an entirely erroneous instrument.

**Discussion.**—Accuracy of Eve's halometer has been investigated previously and although the instrument yielded dependable results in normal individuals (Chaudhuri, 1933), yet in anæmia patients it was shown to be of no practical value, (Napier and Das Gupta, 1936). These workers held the halometer to be responsible for many errors of diagnosis in India. They pointed out that although accurate red cell diameters had a definite positive correlation with colour indices, the Eve's halometer, being an erroneous instrument, showed very often a combination of macrocytosis and hypochromia. From the table it will be seen that, whereas halometric readings show as many as ten instances where macrocytosis is associated with mean corpuscular hæmoglobin lower than 24.77 $\gamma\gamma$ , Price-Jones method shows this combination in only one instance where the mean red cell diameter is just suspiciously macrocytic. The value of correlation between the 31 halometric readings and the corresponding mean corpuscular hæmoglobin values works out to 0.1244, which is not significant. The same correlation value in the case of Price-Jones readings is 0.7103 which is significant at one per cent

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## NOTES ON HUMAN LICE

By MARTIN FRIEDMANN, M.D.  
Yercaud (Salem district)

THE present war awakens in most of the doctors who participated in the war of 1914–1918 many reminiscences that are worth communicating, especially such as are of value for the health of the troops.

We know that all the wars of the past, as for instance the Thirty Years' War, the Napoleonic Wars, the Crimean War, the Turco-Russian War, etc., were accompanied by more or less important lousiness of the armies; the same may happen in this war.

In the last war we learnt above all that the body louse (*Pediculus vestimenti*) is not only responsible for annoyances (loss of sleep, etc.) to those infested and for the development of boils, carbuncles, lymphangitis, lymphadenitis, phlegmons, and superficially suppurative processes with all the possible consequences, but also that they play the greatest rôle in the transmission of typhus, trench fever, and relapsing fever, and possibly other diseases as well. It is necessary to know that these diseases are transmitted by the bite of the infected louse, by its crushed body or from its excreta.

Now that we know the great importance of lice, measures for exterminating them should be considered as necessary as the different protective vaccinations and other hygienic precautions. As it seems probable from recent investigations and experiments that body lice and head lice are varieties of the same species, that one can adapt itself to the conditions of the other, and that crossing of the two varieties is possible, the control of lice has to be extended also to the head louse in conditions of warfare.

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value. These results confirm the findings of Napier and Das Gupta.

**Summary.**—Data reflecting on the accuracy of Eve's halometer have been statistically analysed and it is concluded that the readings of this instrument in anæmia bear no significant relation to the actual average red-cell diameter. It is suggested that, as far as the investigation of anæmia is concerned, the instrument should be 'relegated to the museum'.

**Acknowledgment.**—I wish to thank Prof. P. C. Mahalanobis for being kind enough to get the mathematical calculations done and Dr. L. E. Napier for permission to draw the Price-Jones curves at the Calcutta School of Tropical Medicine.

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Unfortunately some of the most important knowledge regarding the biological habits of the lice that we have gained in former wars has already been forgotten. I have seen a recent article condensed from a publication by Prof. J. B. S. Haldane. Here it is said:—

'The best weapon against the lice is a bath in every home' and 'the body louse spends most of its time in our clothes and lays its eggs there.'

Both these sentences contain true and untrue things, as we shall see.

My knowledge is the fruit of observations I have made during the former war and during my stay in Poland, as leader of a delousing station, constructed according to my own plans, which was attached to a big department for skin and venereal diseases.

My observations contrasted both with those which were recorded in pre-war textbooks before 1914 and with what we were mostly taught up to this date. I can only quote a few opinions here:

Hebra, Kaposi, Sack, Darier and others wrote that body lice attach their eggs exclusively to the seams and fibres of the clothes and under-clothing. Therapeutically it should be sufficient to change the clothes and to disinfect them.

During the delousing operations—I myself have examined every soldier—I was astonished to find that the body louse can also stay on the human body, the favourite regions being the pubes and the hair of the axillæ, especially in cases of intense pediculosis. Unexpectedly, it was found that it deposits eggs on the body hair too.

The same observations have been made by various other observers, e.g., by Pearls in 1916. But the earliest reports sounded so incredible that Pearls, Wollermann and Buscher proved the correctness of these findings experimentally, and in more recent books these facts are apparently forgotten again; for Stitt (1927), Manson-Bahr (1935) and Jadassohn do not mention them. Only Jadassohn declares that lice are sometimes to be found living on the hair; but he does not mention the deposit of eggs there. In the most recent and attractive monograph about the louse by P. A. Buxton (1939) there is clearly described the whole significance, the biology and control of *Pediculus humanus*. There it is pointed out that the body louse 'generally lays its eggs on the inner surface of under garments, but quite commonly on hairs growing on the trunk'. The memorandum of the Ministry of Health (1940) on the louse finally contains the fact that the nits are cemented to the fibres of clothing or to hairs.

Nevertheless the knowledge of the probable stay of the lice on the human body (see Haldane's article, etc.) has not sufficiently spread among medical men.

I believe therefore I am entitled not only to insist on this important fact in my paper, but also on some diagnostic signs, formerly not

mentioned and on some questions about therapeutic and control measures.

According to the newer experiences, it must be concluded logically that for a complete delousing the disinfection of the clothes, under-clothing, and bedding is not sufficient, because the nits on the body are not killed thereby. Even a bath does not effect complete destruction of the lice; it will only contribute to a reduction in the number of lice, for not all lice are carried off by water. It must be added that water is no killing agent for lice nor can it either detach the nits from the hair, nor destroy them. The chitinous cement with which the female louse fixes the eggs to the fibres of the tissue, or to the hair, is resistant to chemical reagents and is not dissolved in water, differing in this respect from that of the bed-bug. If a few nits or a single impregnated female remains, pediculosis must soon recur, for, as we know, every adult female louse lays 8 to 12 eggs daily during her total life-span (4 to 6 weeks). Furthermore, we must consider that one lousy individual will be able to infest others rapidly.

For ridding the body from nits I first tried clipping away the body hair and disinfecting it in a solution of cresol. At weekly intervals I surveyed the deloused men, none of whom had had occasion to leave the hospital and to acquire new lice. But I found a certain number of patients presenting lice again. Therefore I had to conclude that, despite the hair-cutting, several eggs were left. This led me to pursue another course. After the hair cutting I applied on the hairy parts an ointment deleterious to eggs and lice. The most effective is unguentum hydrargyri ammoniati, which was used as long ago as 1748 (Zwinger). It kills the nits with certainty, but their shells remain on the hair for a long time. It is therefore of practical importance to distinguish whether the observed eggs are alive or dead. This question is essential in the struggle, not only against the body louse, but also against the other kinds of lice and even in the destruction of bed-bugs.

It is important not to accept such empty shells as evidence of present infestation; a man carrying such dead or empty eggs will be deloused often and unnecessarily, if the examining person is unable to differentiate between the living egg and the dead.

By what criteria can we test the life or death of the nits?

The living nit presents itself to the naked eye as a tightly-filled, smooth, egg-shaped, pearly-coloured structure with a decided pearl lustre; it has on its top a well-formed lid (operculum). To some extent the shell is transparent, so that the embryo may be distinguished inside it. The dead nit is shrunken, collapsed, dimpled, and discoloured and is without lustre; the empty egg-shells are collapsed, pale-brown and have mostly lost their lids. If the searcher

is not in a position without or with a pocket-lens to rely upon his visual faculty, he may use his tactile and hearing sense. If he crushes a living nit between his thumb-nails\*, or in a pair of pincers, he may feel a marked resistance; if he increases the pressure, the egg will burst with a readily audible noise, a noise which is well known and has often been described in general literature (in antiquity by Herodotus, in the 15th century by Poggio in Italy). In crushing a dead or empty egg there will be neither resistance to pressure nor any bursting noise. But medical men have not used these simple diagnostic signs sufficiently and so far as I know these facts do not appear in medical literature.

For the successful destruction of the parasites in question, the above therapeutic and diagnostic characters should be frequently used and the knowledge of them should be spread as widely as possible.

That a dead body with lice may bring certain dangers is clear for everybody who has had occasion to make suitable observations. Unable to suck blood from the dead, the lice flee from this host; wander away from the dead body until they find a new host whom they attack eagerly.

Another observation I made is with regard to the skill wherewith the lice know how to escape the dangers to their life. The disinfectant in which the infected garments, blankets, etc., are

\*It must be emphasized that it is not advisable to use the thumb-nails, if there is any suspicion of lice being infected with either rickettsia or spirochaetes.

exposed to steam or hot air must be free from cracks and the doors of a delousing apparatus have to be closed tightly. If there be any such small gaps through which cool air can enter a great number of lice will be found near those 'draughty' parts in the walls or doors.

### Summary

1. It is not as well known as it should be that the body louse may attach its eggs to the body hair of its host.
2. Delousing will only be effective if in addition to disinfecting the clothes the hair is treated too. A useful ointment for killing lice and eggs is unguentum hydrargyri ammoniati.
3. By crushing the nits it is possible to determine whether they are alive or not.
4. A dead body with lice may bring special dangers.
5. The delousing apparatus must be free from cracks and gaps.

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## A Mirror of Hospital Practice

### PERSISTENCE OF DIARRHŒA IN ENTERIC FEVER

By SUDHANSHU MOHAN DAS, M.B.

#### Sylhet

*Case 1.*—A boy, aged 16 years, in the latter part of the 4th week of fever in 1931, was running a remittent type of temperature rising up to 103°F. with flatulence and diarrhœa. I failed to control the diarrhœa with the usual intestinal antiseptics and astringents. Keeping in view the possibility of secondary infection I gave the patient one injection of 10 c.cm. anti-streptococcal serum. The diarrhœa instantly stopped and the flatulence abated gradually. His bowels afterwards had to be opened every other day with glycerine enema. Fever gradually came down to normal and he recovered.

*Case 2.*—A man, 45 years old, was under my treatment from the beginning for enteric fever in 1935. In the 5th week, the fever came down to normal in the morning, rising a degree or two towards evening. But the diarrhœa, which gradually developed in the middle of the course of the fever, persisted in spite of usual treatment for its control. On examining the stool, I found many *Entamoeba histolytica* cysts. I then washed out the bowel with 1 per cent silver nitrate solution. The first motion after the wash contained some blood. But the diarrhœa was readily controlled and he made an uneventful recovery.

*Case 3.*—A girl, 9 years old, was under my treatment from the beginning for enteric fever in 1939. In the third week the girl began to pass 10 to 12 stools a day with mucus and blood. The character of the stool was unlike that due to hæmorrhage in enteric fever and resembled more that due to dysentery. I examined the stool which contained pus cells and macrophage cells. I gave her a course of bacteriophage for two days but the motions became more frequent. I then examined the stool again and detected one motile *E. histolytica*. I at once injected half a grain of emetine hydrochloride, the character of the stool improved and the frequency lessened. In two or three days she was passing one normal stool a day. Gradually the fever came down and she recovered.

*Case 4.*—A man, 24 years old, was treated from the beginning for enteric fever in 1941. Towards the latter part of the second week he developed diarrhœa. This complication resisted all the usual intestinal antiseptics and astringents. The frequency of the stool was rather on the increase, coming up to 22 motions in 24 hours. On examining the stools I found pus cells, macrophage cells, one motile *E. histolytica* and a few cysts. Half a grain of emetine hydrochloride was at once injected and a dose of Dover's powder given. The motions came down to 7 in 24 hours. Emetine hydrochloride in the same dose was administered every other day and in three days the diarrhœa totally stopped and he was passing one normal stool a day. In this case the patient did not complain of pain or any other

symptoms of dysentery, the stools also were free from blood and mucus.

### Discussion

In cases of stubborn diarrhoea in enteric fever, where the usual intestinal antiseptics and astringents fail, we should think of amœbiasis. There may be complete absence of pain, tenesmus or other symptoms of dysentery.

As regards case 1, possibly secondary infection was keeping up the diarrhoea. I did not examine the stool in that case.

## ENTERIC TYMPANITES SIMULATING ACUTE INTESTINAL OBSTRUCTION

By HUKAM CHANDRA, M.B., B.S., F.C.M.S.

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A MOHAMMEDAN male was referred as a case of acute intestinal obstruction requiring immediate operation, by a medical officer of a rural dispensary in the district, who had seen the patient a few hours earlier.

*History of present illness.*—Three days previously the patient had a sudden attack of vomiting and purging followed the next day by flatulence and constipation. The abdominal distension went on increasing and the constipation became obstinate without any flatus being passed. There was, however, no more vomiting, though thirst and nausea were prominent complaints. Enemata, administered at the rural dispensary, had no effect and an immediate operation was advised by the medical attendant.

*Previous history.*—The patient, an agriculturist, had always taken ordinary lacto-vegetarian diet with an occasional allowance of meat. The bowels had generally kept regular and he gave no history of any previous abdominal complaints. He denied any indiscretion in diet preceding the present acute trouble.

*Physical examination.*—The facial expression was not characteristic of 'acute abdomen'. Cheeks were flushed, lips and mouth dry, tongue coated with dirty white fur, its tip and margins having a raw appearance. The abdomen was greatly distended with the walls held somewhat rigid. Spleen and liver were not palpable and intestinal movements neither visible nor heard on auscultation. Heart sounds were feeble, pulse 90 per minute, moderately full but easily compressible, respiration rather hurried being 30 per minute and a few rhonchi were present at the pulmonary bases. Temperature 100.5°F., urine scanty and high-coloured with no abnormal constituent. No rash of any kind was visible on the body surface. There was no appreciable wasting, no mental symptoms, and the general condition was quite satisfactory.

The above findings made me sceptical as to the diagnosis of intestinal obstruction and further questioning brought out the fact that the patient had really not been keeping 'quite well' for about ten days immediately preceding the attack of diarrhoea. He had felt disinclined to go about his usual work though he had been doing it. Frontal headache, a bad taste in the mouth, diminished appetite, a tendency to constipation and slight fullness of the abdomen with gurgling at the time of defæcation were experienced during this period. He agreed to the suggestion that these symptoms might have been due to fever.

A provisional diagnosis of typhoid fever was made and the patient admitted into the hospital. The idea of surgical interference was given up for the time being and a conservative line of treatment adopted. Calomel in fractional doses by mouth, enemata of potassium permanganate lotion with added turpentine oil, hypodermic injections of pituitrine and strychnine

and turpentine stupes to the abdomen relieved the retching and thirst, and, although no motion nor wind was passed, the patient felt more comfortable, probably from relaxation of the abdominal walls. Insertion of a flatus tube in the rectum did not prove of any value. In the evening I called the civil surgeon to see the case. He agreed with my diagnosis and advised continuance of the treatment till the next morning. The patient was now put on a mixture containing ammonium chloride grains 10, acid hydrochloric dilute minims 10, liquor strychnine hydrochloride minims 5, liquor hydrargyri perchloridi minims 20 and peppermint water one ounce, four-hourly, and fomentations to the abdomen were continued. Maximum temperature recorded in the evening was 102°F. The general condition gave no cause for anxiety.

At about 4 a.m. the patient passed a lot of flatus *per rectum* followed by two loose motions immediately afterwards and the abdominal distension was considerably relieved. On the next morning the abdomen became absolutely lax, the temperature gradually subsided and general condition distinctly improved. Two nights later the patient had another sudden attack of diarrhoea and passed several loose motions accompanied with tenesmus but there was neither nausea nor vomiting. This was controlled by withholding all food and it was not followed by any abdominal discomfort or tympany. The acid mixture was continued and other measures usually necessary for the successful management of an enteric patient adopted, as required. The temperature declined steadily and became 98°F. three days later with an evening rise up to 99.2°F. Two days later, it did not go beyond 98°F. By this time the patient who had been insisting on returning to his village-home ever since the relief of the abdominal condition could no longer be persuaded to stay in the hospital. There was, he asserted, nothing wrong with him now and that he must go back. Necessary instructions regarding rest in bed and diet were given though it is doubtful whether he carried these into practice. A few days later I heard that he was well and had returned to work.



History of influenza five years ago and dysentery three months ago.

Physical examination showed nothing abnormal except tenderness on deep pressure in the left iliac fossa. The urine and the stool showed nothing abnormal. He had taken all sorts of carminative drugs from various doctors, but with no improvement.

I concluded that the condition had a neurotic basis and referred him to a psycho-analyst. Before he left me, I asked him to send his cousin who had the same trouble.

His cousin, a man of 33, very intelligent and far from being a neurotic, told me that they both had an attack of dysentery three months ago and only after that did they have this trouble. Neither of them had taken any treatment for their dysentery.

*Physical examination*—nothing abnormal; urine—clear. His stool showed *Entamoeba histolytica* cysts and I started intramuscular injection of emetine hydrochloride (P. D.) gr. 1 daily. After 3 grains, his eructations stopped altogether. I finished the course of emetine and sent him home cured, asking him to send his cousin. Emetine was started on this man also and after one injection the eructations stopped. But the whole course was given to him. After one month both were seen again and they had remained well.

*Summary*.—Two cases of continuous eructations having a history of amoebic dysentery were treated with emetine hydrochloride injections. In one case 3 grains and in another 1 grain cured them.

### SIAMESE TWINS

By S. PONNIAH, L.C.P. & S. (Bom.)

*Assistant Medical Officer, Scudder Memorial Hospital, Ranipet, N. Arcot, S. India*

A WOMAN, aged 40, had already had four children and this was the fifth pregnancy. She was well nourished. Her pulse was 120, respiration 30, blood pressure 170/90, and temperature 98.8°F. She was very cedematous—her legs, abdomen, and face were extremely swollen. Labour pains had started 18 hours previously, pains were strong and membranes had not yet ruptured. I advised her to come at once to the hospital, which she did. About one hour after admission, membranes ruptured and labour progressed slowly because of the weakened condition of the patient. The diagnosis of



twins was made and since progress was very slow and the cervix was completely dilated and the head was presenting in the L.O.A. position, I decided to perform a forceps delivery at once. The forceps were applied and the head delivered. But on removing the forceps, the head was pulled again into the vagina in an

abnormal manner. I again pulled the head down, and having the nurse who was assisting me to hold it, I delivered the shoulders and arms. Following the delivery of the head and arms, I made an examination and found a connection between this baby and a second one which was still *in utero*. I then delivered the first baby entirely and at the same time feeling the legs of the second in the vagina, I grasped them and extracted the second baby by breech with some difficulty. The bodies were found to be connected face to face from a point above the ensiform process to a point one inch below the umbilicus. This connection was 3½ inches long by 2½ inches broad at the upper end and 1½ inches broad at the lower end. The connection was centrally situated over the chest of both babies but was placed to one side of the umbilicus on the abdomen of both. The umbilicus of each was still not closed completely and the umbilical cord to each, entered this unclosed opening and was unfortunately not investigated deeper. Each small umbilical cord ran for two inches separately and then they were united into one, which connected with one placenta. The babies were still-born and of the female sex. The intestines protruded through the unclosed umbilical openings as the delivery was being done. Intestines were evidently common to both for, when one loop was pulled down and lengthened, the loop protruding through the other umbilicus was shortened. The total weight was 11½ pounds. They were full term and well formed in every other way. The heads, arms and legs were normal. During delivery the mother's cedematous perineum was lacerated and required suturing. The mother did well after delivery and suffered very little inconvenience. This was a specimen which we should have liked to keep as a museum specimen but the relatives refused to allow this. In fact further detailed examination was impossible as the relatives insisted on taking it away.

### SUPPURATION OF THE MIDDLE EAR TREATED WITH UREA SOLUTION

By DINA NATH VAIDYA, L.M.P., S.S., M.R.S.N.I.

*Medical Officer, The Coleyana Estate Limited, Okara*

A HINDU woman, aged 30 years, came to the hospital with severe pain in the ear, temperature 102.4°F., and headache. The middle and external ear were swollen, red, painful and tender. The patient could not lie on the affected side and was in a grave condition. She was given opening medicine, fever mixture and hot fomentation, and the swelling was painted with tincture of iodine and ichthyol, and bandaged. Next day she came back but with very little relief; she remained sleepless and restless the whole night, crying with pain and tenderness. This hospital being only an outdoor one I could not keep the patient in the hospital but I detained the patient and told her that she would only be allowed to go when there was no pain. She was kept lying down and 2 c.cm. novocain mixed with adrenalin solution was dropped in the ear, after clearing the ear with hydrogen peroxide. She remained in the hospital for three hours in the morning, and during this period novocain was dropped in four times, when she was completely relieved and was discharged from the hospital. In the evening she came again with the same complaint of pain, but not so severe. The same novocain treatment was repeated three times and she left the hospital without any pain. She slept well, bowels moved and there was no fever or headache. After a few days she again attended the hospital with discharge of pus from the ear, but there was no pain or swelling. The ear was thoroughly cleaned with hydrogen peroxide, and pure urea solution was dropped in the ear. This treatment was continued for about ten days and the pus disappeared and the ear was quite healthy.

Heretofore I have never treated cases of middle-ear suppuration with urea. This case

has encouraged me to adopt the urea solution treatment in suppuration of the middle ear. I have used concentrated solution in all sorts of open wounds, ulcers, etc., and the foul smell and pus disappear quite satisfactorily in a very short time. I have tried it in all surgical cases and only recently I have cured two mammary abscesses which were very bad and discharging foul pus, with urea treatment. Urea is a good, harmless and quick healer and may be used in all surgical cases, wounds, ulcers, etc.

### A CASE OF MILD HYPOPITUITARISM

By OWEN BERKELEY-HILL

LIEUTENANT-COLONEL, I.M.S. (Retd.)  
Ranchi, Bihar

X. Y., a Mohammedan from Chota Nagpur, aged 18, consulted me early this year in respect to his sexual potency, in view of his impending marriage. He complained of an inability to obtain a full erection of the penis, no matter how greatly excited he was by desire. On the other hand, he had noticed that his penis was often fully erect on awakening from sleep. He told me that he had had sexual intercourse with two Indian women, to one of whom he believed he had given a child. He admitted to masturbation since the age of 13 as well as to competing with other boys as to who could void urine the highest. Masturbation caused his penis to enlarge and stiffen but never to produce more than a semi-erection. He said he was prone to get a quick semi-erection of the penis when looking at a pretty girl but further investigation of the patient's case leads me to suppose this statement was a piece of wishful thinking, for, like most semi-impotent males, he did his best to ignore his condition and compensate his inferiority feeling by trying to believe to possess a super-potency.

His weight was 112 pounds, height 5 feet 5 inches. His musculature was extremely well developed, except his pectoral, gastrocnemius and triceps muscles. That a powerful youth who had done much physical culture should have such exceedingly poor physical culture was notable. Furthermore, his nipples were infantile. His chest measured 33/35½ inches, waist 26 inches, biceps (in contraction) 12 inches, calves 12 inches, whole body was without hair except for pubic hair which was more feminine than masculine in arrangement. He had a few hairs on his upper lip. His penis was rather small but his testicles were very small, almost infantile. He said he very rarely had a seminal emission during sleep but attributed this to the fact that his semen was 'too thick to pass out'. Subsequent observation led to the discovery that his semen was rather watery for a young man of his age and build. He stated that as a small child (about 7 years old) he had suffered from several attacks of intense abdominal cramps from each of which he was not expected to survive, otherwise he had had no serious illness. He had always been a naughty and mischievous boy for which he was frequently severely thrashed by his father. He is the youngest of three sons. His father is a powerful man and so is the eldest son while the second son is poorly developed. Both the patient and his eldest brother have been much addicted to physical

culture and sports of all kinds. He does not drink or smoke. The systolic blood pressure was 120 mm.; diastolic 70 mm.; pulse pressure 50 mm. According to observations on the blood pressure of healthy boys between the ages of 15 and 19 years, lowest systolic pressure is 105—medium 117—highest 129; lowest diastolic pressure 73—medium 77—highest 81. Hence the patient's systolic pressure tends to be a little high, while his diastolic pressure is rather lower than normal.

The psychological side of the clinical picture revealed a would-be 'Don Juan' temperament. His attitude towards women was characterized by a certain degree of intransigence, cultivated, no doubt, with the view of impressing women with his virility. He was notorious among his friends and acquaintances for his fondness for uttering obscenities. As a matter of fact most, if not all, girls and women disliked him. Of the art of love making, he was completely ignorant. But the most striking feature in his temperament was an immense narcissism. He asked me if I knew of a photographer who would take photographs of him naked. I directed him to a studio in Calcutta. It so happened that the proprietor of the studio to which I directed him had once been a physical culturist. He and advised him to take six months' intensive physical culture and then present himself for photographing. This advice dealt a staggering blow to my patient's narcissism. He begged to be photographed. To satisfy him, the photographer took him in six poses.

The physical characteristics of the case led me to suppose there was some pituitary defect so I referred the case to Lieut.-Colonel J. A. Shorten, I.M.S. (Retd.), who reported as follows:—

#### 'Part examined—skull lateral

X-ray findings.—The sella turcica is shallow and the clinoid processes are poorly developed. The measurements are 10 mm. by 6 mm. instead of 16 mm. by 9 mm. which are the average measurements given by Cushing.

In addition to this, note the almost complete absence of frontal sinuses and the small size of the sphenoidal sinuses.

All these signs point to hypopituitarism of a mild type'.

On the psychological side, I discussed the case with Dr. Girendrashekar Bose of Calcutta, the eminent psycho-analyst. He considered that a strong 'castration complex' was operating and advised a course of psycho-analysis.

It was, of course, obvious that any man who could only obtain a semi-erection would never be able to penetrate the hymen of a virgin, especially if the girl knew nothing of the art of love, which could hardly be expected in an ignorant Mohammedan girl of sixteen years of age who was strictly *purdahnashin*. I watched the approach of the youth's marriage with the greatest apprehension.

At the first intercourse, the youth, filled with a blinding desire to be a complete 'he-man' with his bride, fell upon her with a partially-erect penis and can hardly have done more than ram her in her *fossa navicularis*, thereby causing her fright, embarrassment and pain. He repeated this performance on several occasions but caused the girl so much distress that one night she screamed for her relatives to turn her husband out of the house. This they did and for several months the girl refused even to speak to her husband, far less allow him to have intercourse with her.

If the girl could have been told that her husband is partially impotent, so that for his sake and more especially her own she must, at first, at any rate, only permit him to try in what Van de Velde in his book *Ideal Marriage* calls the 'Attitude of Extension', that is, after the penetration of the penis, the woman, who is lying on her back, closes her thighs and stretches out her legs to their full extent. This attitude is especially successful when the male organ cannot attain full erection. For the man, this attitude has the further advantage of increased stimulation of the penile shaft in a somewhat crude but effective way. The extended attitude of the woman is made more complete by keeping the upper part of her body quite flat and placing a firm hard pillow under her buttocks. Had it been possible to give either bride or bridegroom this information, the sequence might have been averted, but every reader of the *Indian Medical Gazette* will know that the pruriency and false modesty of an uneducated Indian girl is so intense that to try to put across this advice is impossible. To give it to the bridegroom, who entertained great notions of his sexual prowess, in spite of the defective erection which he was feign to ignore, would probably have added to his impotency.

The implications of the above clinical history are, I think, very considerable. They are not only of medical interest, which nowadays includes psychological, but of sociological importance. So long as the importance of sexual knowledge continues to be rather less understood among Indians than it is among most Britishers, these disastrous situations are likely to appear and re-appear *ad infinitum*.

## A LIVER ABSCESS BURSTING INTO THE PERITONEAL CAVITY WITH SIGNS OF INTESTINAL OBSTRUCTION

By P. N. SINHA BARMA, L.M.F.

Medical Officer, Sendra Colliery

R. ROY, M.B.

Medical Officer, Mudidih Hospital

and

T. BHATTACHARYA, M.B.

Pathologist, Messrs. Bird and Co., Sijua

C. B., miner, aged about 40 years, came to the Sendra dispensary on the night of 28th November, 1941, with the following complaints:—

- (1) Swelling of the abdomen—3 days.
- (2) Inability to pass flatus and stools—3 days.
- (3) Pain in abdomen, especially the upper part—3 days.
- (4) Vomiting—3 days ago; none since then.

The patient was emaciated with a distended abdomen. Answered questions with difficulty. Coughing at intervals with slight expectoration. Oedema of the legs and abdominal wall was present and the patient was markedly anæmic. No sign of jaundice

could be detected. The breathing was thoracic in type although a slight movement of the upper part of the abdominal wall was noticeable. There was slight rigidity of the abdominal wall and signs of free fluid in the peritoneum were present. No peristalsis or distended coils of intestine were visible. The abdomen was tender all over. The liver was enlarged and tender. The spleen was not palpable. No distended veins could be seen on the abdominal wall.

Temperature 99°F.; pulse rate 130 per minute; respiration 35 per minute.

The patient was given an enema and a small quantity of liquid stool with blood and mucus was obtained. He was given an injection of atropine sulphate to ease the pain and was sent to the Mudidih hospital.

Here the patient's relatives were questioned and a history of chronic dysentery for the last 3 months was elicited. No rigidity was detected at this time. The soft abdomen without any rigidity and absence of vomiting was a feature that could not be made to fit in with the diagnosis of acute abdominal catastrophe.

The stool was examined after obtaining a small quantity through a thick rubber tube and was found to be teeming with vegetative forms of *Entamoeba histolytica*.

The condition of the patient was very low hence an injection of strychnine sulphate, gr. 1/32 with atropine sulphate gr. 1/100, was given and glucose 25 per cent (25 c.cm. intravenously). Later an injection of emetine hydrochloride gr. 1/4 was given.

The patient died 4 hours after reaching the hospital.

A *post-mortem* examination was held on the following day. On opening the abdomen the coils of intestine were found distended, congested and matted together with plastic exudate. The whole of the peritoneal cavity was full of pus. The greater omentum was adherent to the under surface of the liver. On gently separating this, a big abscess was found protruding at the under surface of the right lobe of the liver with the gall bladder at its left border. The abscess was leaking towards its posterior part. The liver was removed and its upper surface showed a thin layer of purulent exudate situated between the two layers of peritoneum. The lesser sac was full of pus.

On opening the large intestine a large number of typical amœbic ulcers were seen.

The pus in the peritoneal cavity showed pus cells, mostly large mononuclear and degenerating liver cells, but no organisms.

## Discussion

The presenting symptoms of this case were those of intestinal obstruction, *e.g.*, inability to pass fæces and flatus with pain in abdomen and gradual distention. The absence of rigidity was against any inflammatory condition of the peritoneum and we thought it to be a case of amœbic dysentery with hepatitis and possibly abscess. We could not account for the fluid in the peritoneal cavity and it was only the *post-mortem* finding of pus which showed no pyogenic organisms with degenerating liver cells in it that explained the whole picture, except the absence of rigidity. The signs of intestinal obstruction were due to paralytic ileus following the involvement of the peritoneum.

Our thanks are due to our C. M. O., Dr. R. J. Singha, Mr. S. F. Tarlton, the Chief Mining Engineer, Messrs. Bird and Heilgers, and Mr. J. Leggate, Manager, Sendra Colliery, for permission to publish this case.

# Indian Medical Gazette

MARCH

## HEALTH OF THE INDUSTRIAL WORKER

THE war has inaugurated many changes in our social and economic lives which we hope will not be allowed to revert to their previous unsatisfactory state after the war is over. Industry, though it has not, except in a few instances, become nationalized, has nevertheless come into the national limelight and it has to account, not only to its shareholders but to the nation, for its failures and its successes. In the past, shareholders became disturbed and tended to ask difficult questions only in the face of failure; with certain notable exceptions in advanced western countries, they were content to pocket the profits, in the event of success; but now that industry is being subjected to so much outside scrutiny, a change has taken place and two questions are being asked:—Is the success the maximum that could be expected, and at whose expense is it being achieved? In both these cases the question of the health of the worker arises.

The aims of industrial hygiene can be placed under two headings, (i) the prevention of the immediate ill-effects of certain occupations on the industrial worker, and (ii) the maintenance of the mental and physical health of the worker at its highest level, so that his or her output is maximal. In each case there is advantage to both the worker and the industrialist, but in the former it is mainly the worker, saved from crippling disabilities, whose interest is served, and only indirectly that of the employer who would otherwise lose his trained worker and may have to compensate him; in the second case, the advantage goes mainly to the employer who gets the benefit of a greater output and better work, and only indirectly to the worker whose health is often maintained at a higher standard than that of the general population from which he comes.

The serious disabilities that some occupational groups suffer from, such as pneumoconiosis, lead poisoning, and the industrial dermatoses, have attracted the attention of the public and, in some instances, have eventually stirred the conscience of the industrialist, in others his interest has been forced by workmen's compensation acts. In most western countries the bill that has to be paid annually, for working time lost, medical care, and compensation, is so large—a recent computation in the United States placed it at 660 million dollars—that naturally employers are beginning to pay very special attention to industrial hygiene, and are inaugurating and supporting investigations into the preventable causes of both industrial accidents and industrial disease.

Industrial medicine originated with the present industrial era, for all practical purposes—though Hippocrates described silicosis—but it has received such a very great impetus during the last decade that it is often looked upon as a new branch of medical science, and within the last few years a formidable literature on this subject has begun to appear.

A recent important publication, *Industrial Hygiene*,\* by various American writers deals with the subjects from an administrative as well as a medical point of view, but it is confined almost exclusively to conditions as they exist in the United States. From Great Britain, Collier's *Outlines of Industrial Medical Practice*†, whilst being a comprehensive survey and including chapters on the medical aspects of occupational diseases, tends to emphasize the legal provisions and the regulations that have to be complied with in that country. In *Health in Relation to Occupation*‡, Dr. H. M. Vernon approaches the subject in a more general way, commencing with the effects of heredity, nutrition, and the economic factor, and later dealing with mortality and sickness in different occupational groups.

In these and most other pre-war publications—pre-war in outlook if not in actual date of appearance—what we considered above as the first aim of industrial hygiene, namely the prevention of general and specific illness amongst workers, mainly for the worker's sake, is the point of view that is given primary consideration. In this 'all-out' war, the second aim, namely the maintenance of a high level of physical and mental fitness in the worker for the sake of the work that he does, so that his output may be maximal, is now becoming the more prominent consideration. This aim is a higher one—though it may be less personal and might be described as soulless; its object is to keep the worker not only on his feet but at the top of his form, and it must therefore be comprehensive.

The seeds of this movement were sown during the last war with the formation of the Health of Munition Workers Committee which was followed by the Industrial Fatigue Research Board and eventually by the foundation of the National Institute of Industrial Psychology. During the intervening years, the growth has been slow and at times barely perceptible, but war again gave the necessary stimulus and some of the fruits are now being applied with

\* *Health in Relation to Occupation*. By H. M. Vernon, M.A., M.D., 1939. Oxford University Press, London. Humphrey Milford. Pp. viii plus 355. Price, 15s. Illustrated. Obtainable from Oxford University Press, Bombay and Calcutta.

† *Industrial Hygiene*. By various authors. Edited by A. J. Lanza, M.D., and Jacob A. Goldberg, M.A., Ph.D. 1939. Oxford University Press, London and New York. Pp. xvi plus 743. Illustrated. Price, 56s. Obtainable from Oxford University Press, Bombay and Calcutta.

‡ *Outlines of Industrial Medical Practice*. By Howard E. Collier, M.D. (Edin.), Ch.B. 1940. Edward Arnold and Company, London. Pp. vii plus 440. Price, 21s.

considerable advantage to munitions output in England.

A recent publication, *Health and Efficiency of Munition Workers\**, again by Dr. H. M. Vernon, deals mainly with this aspect of industrial hygiene and the writer applies experiences of the last war to the present one. His principal chapters are on hours of work, rest spells, the shift system, etc., and in short on how one can get the best out of the human machine without breaking it down.

In India, we have scarcely made a beginning. Some larger industrial concerns have their own medical staffs, but these are mainly concerned with medical relief and ordinary public health measures of prevention, such as anti-malarial work. A few of the large industrial associations, e.g., the tea, jute and mining associations, have generously endowed research on diseases from which their employees are liable to suffer, but the factory worker, in the factory, has seldom been the subject of any direct investigation.

The Report of the Royal Commission on Labour in India drew attention to the necessity for industry in India being conducted as efficiently as possible. The British Industrial Health Research Board and its researches were cited to indicate the importance of scientifically designed investigations to enable the various branches of industry to adopt improvements in practice which would lead to increased efficiency. The Commission recommended that comparable research in India was called for. This recommendation, made in 1931, has not been implemented and in 1942 the developments arising out of the war make the need even more urgent.

The headings under which research has been carried out in Great Britain, as indicated in the last annual report of the Industrial Health Research Board, show the wide fields deemed necessary for investigation, covering, as the

headings do, hours of labour, environmental conditions such as lighting, ventilation, etc., methods of work; vocational suitability, and industrial sickness including labour wastage and occupational disease. Other industrialized countries are conducting research on similar comprehensive lines, but as yet there are no signs of any such activities in India.

This country is making a serious mistake in failing to include the safeguarding of the health of the workers in its already significant plans for not only expanding industries but for training cadres of technical workers. While the framers of this new industrial machine, and the Government of India in particular, must be held eventually responsible for any failure to correct this defect in the organization, the initiative lies with the medical profession and more especially the highly placed expert medical advisers to the Government—to urge the necessity for specific study of problems of industrial health and prevention of disease in relation to the special social and climatic conditions of India. The first step appears to be the constitution immediately of a small committee composed of technically competent persons, without regard for seniority, representing physiological hygiene, medical engineering and Indian medical administration. The recommendations of this committee should constitute the point of departure for initiating as quickly as possible steps which may be inaugurated to conserve and increase the efficiency of India's growing industrial war effort.

No committees and no official organizations will be of any real avail unless there exists in the minds of the medical profession in India a growing appreciation of the importance of industrial hygiene, not only as a war measure, but as necessary to complete the health organization in a country that is undergoing rapid industrialization.

\* The Health and Efficiency of Munition Workers. By H. M. Vernon, M.A., M.D. 1940. Oxford University Press, London. Humphrey Milford. Pp. 138. Illustrated. Price, 8s. 6d. Obtainable from Oxford University Press, Bombay and Calcutta.

#### CORRIGENDUM INFANTILE BERI-BERI

In the February number, page 97, column 1, the 14th line of the second paragraph should read 'within 24 to 48 hours'.

## Special Articles

### THE ASSESSMENT OF VITAMIN NUTRITION

By N. C. DATTA

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It is only recently that many inquiries into the state of nutrition of large groups of people are being made. Any investigation on the assessment of nutrition, either in nutritional research or in the clinical laboratory, emphasizes the need of reliable and practical methods for detecting the presence of partial or latent deficiencies in human subjects. Chemical, physical,

and biological methods have been elaborated during the past few years for the assay of certain vitamins in body fluids. Chemical and optical methods offer the advantage of speed and reproducibility; the biological methods afford the most reliable means of estimating the physiological activity of the vitamins. Many of the methods that have been used as a clinical test in assessing the vitamin nutrition are still in the experimental stage. With the rapid extension of our knowledge, it may soon be possible to have simple reliable tests which will meet with universal approval. It is also expected that, with further development of the clinical laboratory

determination of state of vitamin nutrition, more will be learned of the effect of vitamin deficiency on bodily function. Then, many cases of ill-health which are now considered to be of obscure origin, may receive proper diagnosis and appropriate treatment.

#### *Vitamin A*

The first chemical method developed for the assay of vitamin in body fluids was based on the observation by Carr and Price in 1926, of a blue colour which develops when vitamin A reacts with antimony trichloride in chloroform solution. The intensity of the blue colour is measured by means of an instrument called the Lovibond tintometer. The earlier results of analysis on the vitamin-A content of blood are reported to be unreliable because of the inadequate methods of extraction and the separation of interfering substances. In 1935, van Eekelen and Emmerie introduced an improvement by way of heating the serum with potassium hydroxide before extracting it. Dann and Evelyn (1938) used a photo-electric colorimeter which permits the reading of the blue colour at its maximum so that the error due to waxing and waning of the colour could be eliminated. Lindqvist (1938) reported wide variations in the vitamin-A value of blood in apparently normal subjects. The significance of blood determination of vitamin A yet remains to be solved.

*Dark adaptation as a test for vitamin-A deficiency.*—The symptom of vitamin-A deficiency which has been most studied is hemeralopia or night-blindness. The relationship of diet to night-blindness was recognized by a number of investigators, but Bloch (1921) clearly stated that night-blindness was due to a deficiency of vitamin A. A new light was thrown on the subject when Fridericia and Holm (1925) showed that vitamin A plays an important part in the reversible conversion of visual purple into its leuco-derivative. The exact rôle of vitamin A in rod vision and its relation to rhodopsin or visual purple was first elucidated by Wald (1938). He showed that rhodopsin, which is concerned with the reception by the eye, is bleached by light, and the yellow pigment *retinene* is formed. Some of the retinene is rapidly converted to rhodopsin in the dark but some is converted to vitamin A. The vitamin A so formed is then slowly reconverted to rhodopsin. The rate of regeneration seems to depend on the concentration of vitamin A in the retina. It is natural to expect, therefore, that the delayed regeneration of visual purple would be one of the earliest signs of vitamin deficiency.

Numerous attempts have been made to use the dark-adaptation test as a measure of vitamin-A deficiency. The basis of dark-adaptation test is the observation that the ability of a person deficient in vitamin A to see a dimly illuminated object in a dark room is diminished or that, after he has been exposed for a certain period to bright light, the rate of his recovery of that

power is delayed. The method was first put to test by Jeans and Zentmire in 1934, by means of the Birch-Hirschfeld photometer. The extensive studies by Hecht (1937) of dark adaptation furnish the basis for clinical application. The results, however, appear to be somewhat conflicting. Harris and Abbasy (1939) pointed out that most of the discrepancies in the correlation of dark adaptation with vitamin-A deficiency have been by those using the biphotometer. In view of variable results obtained by different workers, it is stressed that dark-adaptation test is only capable of detecting deficiency and not of assessing with accuracy the different level of normality. Hecht (1937) has shown that rods and cones differ in their dark adaptation. He pointed out the desirability of testing a known segment of the retina because of the difference in the distribution of rods and cones.

Night-blindness occurring in vitamin-A deficiency is apparently due to a failure of regeneration of visual purple in the absence of vitamin A. There may be a number of other causes of night-blindness in addition to deficiency of vitamin A. Sydenstricker and his associates (1940) reported that 'dimness of vision is a common symptom of riboflavin deficiency in human beings'. Kimble and Gordon (1939) reported that individuals who failed to improve their dark adaptation with vitamin-A supplements were successfully restored with the addition of riboflavin to their diet. In those who failed to improve with riboflavin, ascorbic acid supplement produced satisfactory improvement. It seems probable that many of the discrepancies concerning the relation of vitamin A and dark adaptation are due to the varying techniques and also to the influence of other vitamins on dark adaptation. Although the elimination of the influence of unrelated ocular conditions is essential for accurate assessment of vitamin-A deficiency, the dark-adaptation test, with all its limitations, is considered to be one of considerable practical value in assessing the state of vitamin-A nutrition.

#### *Vitamin C*

Until 1932, biological methods were the only methods available for the estimation of vitamin C. In 1932, Tillmans *et al.* reported that vitamin C is a reducing substance and developed a chemical procedure for the determination of vitamin C, based on the quantitative reduction of an oxidation-reduction indicator 2:6 dichlorophenol-indophenol. The reaction is not specific for vitamin C, since body fluids contain other substances which also cause reduction of the dye indicator. In blood, we have other reducing substances, which are present only in small amount and, therefore, cause the reduction slowly. It has also been reported that a large part of the reducing capacity of the urine is due to substances other than vitamin C. Mindlin and Butler (1938) described a method in which they used a photo-electric colorimeter to



eliminate the influence of other interfering substances. Recently, metaphosphoric acid has been used successfully for the extraction of ascorbic acid. By this means ascorbic acid oxidase activity and the interference of copper are prevented.

*Urinary excretion of vitamin C.*—Vitamin C is excreted in the urine. The urinary excretion of vitamin C has been taken as a measure of vitamin-C deficiency. A normal adult not suffering from latent scurvy should excrete about 15 mg. of ascorbic acid per day. Excretion of less than 10 mg. may be taken as an indication of latent scurvy. The total excretion of ascorbic acid in the urine is determined by titration of a known volume of the urine with standard solution of the dye; the reaction of the urine being adjusted to pH 2 to 3, in order to eliminate the effect of other reducing substances. According to Harris and Ray, the amount of vitamin C in the urine excreted between 7 and 10 a.m. may be taken roughly as equivalent to one-tenth of the day's output.

The *saturation test* devised by Harris and Ray (1935) gives a much more objective and reliable indication of the nutritional status with respect to this vitamin. The procedure is to determine the ascorbic acid content of 24 hours' urine by the usual method of titration with a standard solution of the indicator. The subject is restricted to his usual diet and then given a test dose orally of pure ascorbic acid, usually about 600 mg. for an adult of average size and less for children, depending on approximate body-weight. The urinary excretion of ascorbic acid is then followed. In subjects well-nourished with respect to vitamin C the excretion curve rises rapidly to a high level and quickly decreases to the basal level. In subjects, deficient in vitamin C, the curve rises to a low level and gradually recedes to a level which is slightly higher than the basal, depending on the extent of vitamin-C deficiency.

The *blood level* of vitamin C is an useful criterion in cases of mild deficiency. In order to eliminate the influence of small amounts of other reducing substances in blood which cause slow reduction of the dye, Pijoan and Klemperer (1937) have modified the method of titration by taking into account the speed of titration and the proper choice of end point. Their method is now being extensively used for the determination of vitamin C in blood.

*Capillary fragility test.*—The capillary fragility test devised by Göthlin (1933) is based upon the idea that vitamin C is necessary for the formation of intercellular material which is the foundation of all fibrous structures. This cementing substance holds together the single layers of endothelial cells which form the wall of the blood capillaries. When the cement fails on account of the lack of vitamin C, the blood vessels are weakened and become permeable to blood. The degree of fragility of the capillaries seems to correspond to a certain extent with the

degree of deficiency of vitamin C. The test is, therefore, applied to determine the degree of fragility of the vascular wall, either by producing venous stasis by constriction of the capillaries or by distension by suction with a cupping glass. The number of petechiæ appearing at a given pressure, measured by a pressure gauge, is taken as an indication of the degree of deficiency of vitamin C. The 'capillary resistance' test appears to be fairly reliable when infants and young children are being investigated, but is unreliable when applied to adults.

*Intradermal test.*—The intradermal test is based on the time taken for a small quantity of a solution of the indicator 2:6 dichlorophenol-indophenol, injected under the skin to lose its colour. The test is gaining considerable popularity and the results are reported to be in agreement with those of the more accurate methods.

#### *Vitamin B<sub>1</sub>*

The chemical methods for the estimation of vitamin B<sub>1</sub> are less completely established. Jansen (1936) devised a procedure for the determination of vitamin B<sub>1</sub> based on the formation of a fluorescent derivative thiochrome, first observed by Peters. The principle of the thiochrome test is the partial oxidation of vitamin B<sub>1</sub>, by means of a mild oxidation with potassium ferricyanide into the fluorescent derivative thiochrome, and to measure the degree of fluorescence against some suitable standard. Westenbrink and Goudsmit (1937) applied this test for the estimation of vitamin B<sub>1</sub> in urine for clinical purposes. The principal difficulty with the method as applied to urine has been the presence in urine of various non-specific substances which may interfere with the measurement of fluorescence upon which the thiochrome reaction depends. According to the procedure adopted by these authors, the vitamin B<sub>1</sub> is first adsorbed on franconite and the fluorescence is subsequently measured by a photo-electric fluorometer. Wang and Harris (1939) have introduced a number of modifications in the original technique, which have greatly improved the simplicity and the sensitivity of the method, and the results given by the procedure agreed with those obtained on the same specimen of urine by biological assay. The special feature of the technique is the omission of any adsorption process and the removal of the interfering substances by preliminary extraction of urine with isobutanol and subsequent washing of the final isobutanol solution of thiochrome with water. According to these authors direct visual comparison of fluorescence seems to be desirable for the sake of simplicity and saving of expense and time.

*Urinary excretion of vitamin B<sub>1</sub>.*—The estimation of vitamin B<sub>1</sub> in the urine was suggested by Harris and Leong (1936) as a method of assessing the body 'reserve' of the vitamin. The urinary excretion was found by Birch and

Harris (1934) to be dependent on the past intake, being low for example in beri-beri, and in 'conditioned' polyneuritis. Since then a number of investigators have measured the urinary excretion of vitamin B<sub>1</sub> and confirmed the fact that it is correlated with the nutrition of the body. Wang and Harris also observed low excretion in conditioned deficiencies and attributed it to anorexia or faulty absorption of the vitamin. They found the daily excretion of most of the normal individuals whom they examined to lie between 150 to 240 mg. Westenbrink and Goudsmit (1938) are of opinion that individuals excreting over 100 mg. of vitamin B<sub>1</sub> are saturated with the vitamin. A close correlation between the dietary history and urinary excretion of the vitamin was observed by Robinson, Melnick and Field (1940). Their studies on experimental vitamin-B<sub>1</sub> deficiency indicate that urinary excretion falls off very promptly when an inadequate diet is taken. They suggest that urinary response to a test dose is then needed to evaluate the body stores.

Harris and co-workers (1938) recommended that for assessing the level of nutrition of a human subject measurement should be made first of the 'resting level' of excretion and then of the response to standard test doses, the latter giving information as to the degree of the saturation of the tissue. According to Wang and Yudkin (1940), any attempt to assess the state of nutrition of any individual in respect of vitamin B<sub>1</sub> by the estimation of 'resting level', without the administration of test doses, is liable to lead to false conclusions. In the first place, owing to the variations existing among the individuals, the excretion gives only an approximate indication of the intake. Secondly, the excretion varies so rapidly with the intake that it reflects to a large extent on the diet being consumed within the day or two preceding the test. Administration of 'test doses' seems to be essential for the detection of the presence and degree of deficiency. The morning excretion of vitamin B<sub>1</sub> after a 1 mg. 'test dose' as a rapid test of nutritional level, as suggested by Westenbrink and Goudsmit (1938), has been reported by Hills (1939) to give a more reliable guide than the 24 hours' excretion.

Pyruvic acid is a normal intermediate product of carbohydrate metabolism. The pyruvic acid content of blood and urine has been studied in relation to vitamin-B<sub>1</sub> nutrition. The estimation of pyruvic acid in blood and also the determination of bisulphite-binding substances of the blood, cerebrospinal fluid and of urine were suggested by Platt and Lu (1936) as a useful criterion in the diagnosis of the vitamin-B<sub>1</sub> deficiency. The same authors in (1939) observed increased pyruvic acid in blood of all cases of fulminating and in a number of cases of sub-acute beri-beri. A practical issue of their investigation on blood pyruvate during exercise is the use which can be made of exercise combined with the measurement of blood

pyruvate to reveal latent vitamin-deficiency states. The 'exercise test' will have limited value because of the inability of the patients to engage in a heavy effort. It is suggested, therefore, that a modification may be made based on the determination of blood changes following a measured amount of work in a limb in which venous return is obstructed.

Meiklejohn (1937) described a method based on the ability of vitamin B<sub>1</sub> to promote the growth of fungus *Phycomyces blakesleeanus* for estimating vitamin B<sub>1</sub> in blood. Sinclair (1938) has shown that the method does not provide a quantitative estimate of the true vitamin-B<sub>1</sub> content of the blood, since blood invariably contains substances other than vitamin B<sub>1</sub> that affects the growth of the fungus. In 1939 he described a modification of Meiklejohn's method which can be employed for the total vitamin B<sub>1</sub> in blood and suggested that a value of 4.5 mg. per 100 c.cm. or less for human blood is considered to be significantly low.

#### Nicotinic acid

When in 1937, nicotinic acid was found to be a specific cure for black tongue in dogs and for pellagra in human beings, it became necessary to devise methods to estimate in urine, with the object of determining the 'level of nutrition' of this vitamin. A method based on the colour reaction given by pyridine derivatives with 2 : 4 dinitrochlorobenzene has been recommended by Vilter *et al.* (1938) for the estimation of nicotinic acid in urine. The results obtained by the use of this procedure were found to be widely divergent from those obtained by the more recent methods based on the colour test for pyridine derivatives, introduced by König in 1904, namely the reaction with cyanogen bromide plus aromatic amines. Swaminathan (1938), Bandier and Hald (1939), Harris and Raymond (1939) and others have recently described a test for nicotinic acid based upon the same reaction. Harris and Raymond claim that the method is so planned as to circumvent the operation of various disturbing factors. The special feature of the method is the preliminary heating of the urine with NaOH to convert any amide into acid and to neutralize it. The specimen is divided into four equal portions; one is kept blank and to the other three are added 0, 20, and 40 mg. of nicotinic acid. The three solutions, which are kept protected from light, are all treated in the same way, being in turn warmed with CNBr, cooled, treated with *p*-aminoacetophenone, allowed to stand, acidified and then the three colour intensities measured in a Pulfrich photometer with S 47 filter, comparing with the blank to which no CNBr has been added. In man urinary output has been found to vary according to the intake and rise after a test dose. Lowered values were found in pellagra and anorexia. The normal range of values was usually from 3 to 5 mg. per day. They suggest that further

detailed work is still needed to establish exact quantitative standards of normality. Robinson, Field and Melnick tried various methods of 'saturation' test and seem to have found not much promise for the direct laboratory diagnosis of nicotinic-acid deficiency (unpublished).

The occurrence of an abnormal 'porphyrin-like pigment' in the urine of the pellagrins reported by Beckh, Ellinger and Spies (1937) appears to be of considerable interest. Spies and associates (1938) reported that in 16 pellagrins receiving vitamin supplement, the pigment excretion in the urine returned to normal in from one to six days. But in 4 pellagrins on a basal diet without vitamin supplement, the pigment excretion also returned to normal, but not for four or six weeks. The excretion of these pigments has also been reported in the urine of patients with disease other than pellagra. Field and Melnick (1940) suggested that the possibility of an associated vitamin deficiency in such patients and the relation of such pigment excretion to liver diseases deserve further investigation.

### *Riboflavin*

Very little work has been done on the riboflavin content of human body fluids. Chemical and physical methods for the determination of riboflavin have been developed. A blue-green fluorescence exhibited by riboflavin in ultra-violet light serves as a basis for its determination by the fluorometric method. The general principles of these methods are the extraction of the flavin with water, dilute alcohol and dilute acetone; adsorption on fuller's earth and elution with dilute pyridine; estimation of the riboflavin content of the eluate by comparing the fluorescence with that of solutions of known riboflavin content. The method recently described is that by Ferrebee (1940) for the estimation of riboflavin in urine, in which the optical system is a definite improvement over that of previous methods. The results obtained by the methods as compared with other methods indicate good specificity and accuracy. Vivanco (1935) reported that in experimental riboflavin-deficient rats there is an early drop in the urinary excretion of the vitamin. A similar drop in the urinary excretion in human beings and the subsequent response to test doses reported by Emmerie (1937) indicate that the urinary excretion may be used as a measure of riboflavin nutrition in man.

### *Vitamin D*

The general function of vitamin D is probably to facilitate the assimilation of calcium and phosphorus in the body and thus create a favourable condition for the calcification of growing bones. Imperfect calcification due to the deficiency of vitamin D can be detected by x-ray examination of the wrist. There is general agreement that x-ray signs frequently

fail to parallel clinical signs. An earlier indication of pre-rachitic condition is the excess of enzyme phosphatase in the blood. This increased phosphatase appears before clinical or radiographic signs and even before changes in the calcium and phosphorus level of the blood. Bodansky and Jaffe (1934) concluded that the level of serum phosphatase is an excellent index to the activity of rickets and also a measure of rate of healing. The phosphatase content of blood of presumably healthy children has been found to vary between 50 to 200 units (1 unit being defined as the amount of enzyme required to release 1 mg. of phosphorus from its organic compounds in 24 hours at 37°C.). Any value over 300 indicates definite active rickets.

### *Conclusion*

The gross pathological conditions associated with the more extreme deficiencies are sufficiently characteristic to be easily recognized, but in the many cases of less apparent deficiency disease causing ill-health, the signs and symptoms are rather indefinite and of a nature that might be produced by other causes. There is the same uncertainty regarding the chemical and biological tests used in assessing the state of vitamin nutrition in human subjects. Thus, hemeralopia or night-blindness may occur due to a number of causes in addition to deficiency of vitamin A. The blood phosphatase may be increased in various bone conditions and also in other diseases. The clinical tests used for vitamin C in urine are not strictly specific for vitamin C, since it is reported that a large part of the reducing capacity of the urine is due to substances other than vitamin C. There is, therefore, the need of exercising great caution in interpreting the results of these tests. Although the subject is still in the experimental stage, it may ultimately prove to be of great practical importance in clinical medicine. Sir John Boyd Orr (1940) suggests that 'what is needed at the present time is a closer linking up of laboratory research and clinical observation'. A close co-operation between the laboratory worker, the expert clinician and the school medical officer, who has to deal with a large number of children, the majority of whom, being in the border line of deficiency, are likely to make important contributions, to our knowledge, of vitamin nutrition, will prove to be of the greatest value in the field of preventive medicine.

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## BLOOD AND PLASMA TRANSFUSION\*

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THE difference between scientific medicine, sometimes known in this country as Western medicine, and the various traditional systems of medicine that have been practised in the past in many countries—and are still practised very widely in India to-day—is that scientific medicine is progressive. Scientific medicine grew directly out of a traditional system of medicine, a system that was based on the teachings of that great Greek physician Galen. Galen lived in the second century, and his teachings dominated all medical practice in the Western world for fifteen hundred years. During these dark ages, men and women were burnt at the stake, not only because they differed in their religious beliefs from the reigning prince, or from the bishop in power at the time, but because their medical teachings and practices deviated from those laid down by Galen. If Galen had said that it was so, it was so, and it was heresy to contradict the statement. All controversy centred round the interpretation of Galen's writings; his authority could not be questioned. There must have been smouldering suspicion in the minds of many practitioners of those days that Galen was sometimes wrong, but it took bold spirits, such as Harvey, to express these doubts publicly. When Harvey described the circulation of the blood the first serious blow was struck at the foundations of Galen's teachings, and scientific medicine was born.

Scientific medicine grew slowly at first, but the advance has been speeded up very considerably during the last hundred years, so that to-day the pace is sometimes a little bewildering even to the practitioners of scientific medicine themselves, and the layman is liable to say 'I don't hold with all these new-fangled ideas; what was good enough for my father is good enough for me'. If that were the universal attitude and we were prepared to accept it, it would make the life of the medical man much simpler, but it would mean that we abandoned our claim to be practitioners of scientific medicine. We do not despise what our fathers taught us; we do not despise what we can gather from the traditional systems, those of the past or those that are still practised; but we accept nothing without questioning, without first testing it by modern scientific methods. We apply all that we find good from the past and we continue to add to it the scientific discoveries of the present age.

\* Being a 'Burdwan Lecture' given on the 6th February, 1942. The Burdwan Lectures are a series of special lectures given annually at the Ronaldshay Medical School, under an endowment scheme founded by the late Maharajadhiraja, Sir B. C. Mahtab Bahadur, G.C.I.E., K.C.S.I., I.O.M., LL.D., of Burdwan.

The present speed of scientific advance is, I have said, at times bewildering to the medical man; it will be much more so to the layman, who often accuses us of continually changing our minds. He will say, 'A few years ago you told me that serum was the last word in the treatment of pneumonia, last week you told me that sulphapyridine had revolutionized the treatment of this disease, and to-day you tell me that in sulphathiazole you have a better drug. When am I to believe you?' What is worse, they accuse us of going round in circles. They say 'why that treatment was discarded a hundred years ago, and you tell me that it is the latest form of treatment?' We smile tolerantly; we can usually afford to do so, because we know just why the method was discarded a hundred years ago and just why it has been taken up again to-day. Just a little fact that science has provided during these hundred years has made all the difference between failure and success.

Blood transfusion provides an excellent example of a form of medical treatment that has been repeatedly taken up and dropped again. The idea that blood was a strength-giving fluid is a very old one. The Egyptian Pharaohs used to have the life-blood of their enemies and slaves poured over them. It did not do them much good, apparently, so the practice was abandoned, but there is evidence that this idea recurred again at frequent intervals during historical times. Then, when the circulation of the blood was discovered by Harvey, the idea of giving this life-saving fluid directly into the circulation soon followed, and, in 1665, a Cornish physician transfused blood from one animal to another. Denys de Montpelier, physician to Louis XIV, is credited with giving the first blood transfusion to a human being, but by this time the practice must have been common for it is mentioned by Pepys in his famous diary. However, the practice fell into disrepute and it was banned in England by the Royal Society, by the Académie de Médecine

abandoned. Then, in 1900, came Landsteiner's great discovery of the blood iso-agglutinins and iso-agglutinogens, and the whole practice of blood transfusion was changed from a matter of pure chance to a controlled scientific procedure. He discovered that different people belong to different blood groups and showed that if one was transfused with blood of the right group all was well, but, if not, immediate death might result. Science had supplied that little fact that made all the difference, and blood transfusion had come to stay.

Landsteiner and those who followed him showed that in the human serum there are iso-agglutinins and in the red cells there are iso-agglutinogens, and that when blood from two different persons is mixed, if the iso-agglutinin comes in contact with the appropriate iso-agglutinin the red cells will agglutinate. If the agglutination takes place within the blood vessels during a blood transfusion, the patient is likely to die suddenly. It was found that there are two iso-agglutinogens A and B and two corresponding iso-agglutinins  $\alpha$  and  $\beta$  and that the blood of the human race is divided into four groups, according to whether their red cells (see table, column 2) contain—

both iso-agglutinogens, A and B  
one iso-agglutinin only, namely, A  
one iso-agglutinin only, namely, B  
or no iso-agglutinogens

An American investigator, Moss, applied the four numbers, I, II, III and IV, to the four different groups (see table, column 1), and all would have been well had not another investigator in Europe, Jansky, given different numbers to the groups. This of course led to confusion until a committee of the Health Organization of the League of Nations decided on a new, a very simple and rational, nomenclature, based on the agglutinin content of the red cells, namely, AB, A, B, or O (see table, column 4).

TABLE

| 1    | 2                            | 3                                | 4              | 5                      | 6                 |
|------|------------------------------|----------------------------------|----------------|------------------------|-------------------|
| Moss | Red cells                    | Plasma                           | Inter-national | May receive blood from | May give blood to |
| I    | Both iso-agglutinogens       | No agglutinins                   | AB             | AB (A, B or O)         | AB only           |
| II   | One iso-agglutinin, namely A | $\beta$ (anti-B) agglutinin      | A              | A (or O)               | A (or AB)         |
| III  | One " " " B                  | $\alpha$ (anti-A) "              | B              | B (or O)               | B (or AB)         |
| IV   | No iso-agglutinogens         | $\alpha$ and $\beta$ agglutinins | O              | O only                 | O (or A, B or AB) |

in France, and by the Pope in Rome. It was revived 150 years later in England by a Guy's Hospital obstetrician. This doctor is said to have saved many patients by this method; he must have been a lucky man, for it was only chance that saved his patients' lives. Again the practice enjoyed a short period of popularity and once again it was more or less

So much for the agglutinogens, but what about the agglutinins in the serum? In every case these must conform, for, if the patient's serum were to contain  $\alpha$  (or anti-A) agglutinin and his red cells A agglutinin, he would agglutinate his own red cells. Such a condition would be incompatible with life, and, therefore, if we know the agglutinin content of an individual's

red cells, we can deduce the agglutinin content of his serum. Thus, an AB individual has no agglutinins, an A individual has  $\beta$  (anti-B) agglutinins, a B individual  $\alpha$  (anti-A) agglutinins, and an O individual both  $\alpha$  and  $\beta$  agglutinins (see table, column 3).

The agglutinogens present in blood are much stronger than the agglutinins. So the first danger in a transfusion comes from the donor's red cells and if the recipient's serum contains any agglutinins at all, that is to say, if he is of groups A, B or O, with serum containing  $\beta$  (anti-B),  $\alpha$  (anti-A), or  $\alpha$  and  $\beta$  agglutinins, respectively, he can only be given blood from persons whose red cells do not contain the corresponding agglutinin, that is, if he is group A (and has  $\beta$  agglutinins) he must be given group A blood (containing only A agglutinogens or group O blood (containing no agglutinogens), if he is group B (with  $\alpha$  agglutinins) he must be given group B blood (containing only B agglutinogens) or group O blood (containing no agglutinogens), and if he is group O (with both  $\alpha$  and  $\beta$  agglutinins) he must be given group O blood (containing no agglutinogens). If, however, the recipient is group AB his serum contains no agglutinins and he can be given any kind of blood—such a person is known as a *universal recipient*. You will also have noticed that group O blood—which has no agglutinogens—can be given to a patient of any group and a person of group O is known as *universal donor*.

So much for the first danger, from the donor's red cells, but what about his serum? The donor's serum contains agglutinins. Agglutinins are weaker than agglutinogens, and so if the blood is given slowly and not in large amounts the serum will be diluted by the recipient's blood and no agglutination of his red cells will occur, but if it is given fast and in large amounts there is a danger that the recipient's red cells may be agglutinated by the donor's serum. This danger applies particularly when the universal donor gives blood to a person not of his own group, especially if his agglutinins are present in high titre; a person with agglutinins present in high titre is known as a *dangerous universal donor* and should only be used to give blood to persons of his own group.

This danger also applies when a universal recipient receives blood from anyone other than his own group. For example, when he receives A-group blood the serum of which contains  $\beta$  (anti-B) agglutinins, these agglutinins, if in high titre, may agglutinate his red cells which contain the B agglutinin. These dangers make it imperative that whenever a blood transfusion is to be given a direct cross-matching—that is to say, a matching of the donor's red cells against the recipient's serum and the recipient's red cells against the donor's serum—should be done.

To summarize, an individual of group AB may be given group-AB blood, or groups A, B and O

with certain precautions; one of group A may be given group-A blood, or group-O blood with certain precautions; one of group B may be given group-B blood, or group-O blood with certain precautions, and an individual of group O must be given only group-O blood (see table, column 5).

A donor of group AB may give blood only to a recipient of group AB; a donor of group A may give blood to a recipient of group A, or to a recipient of group AB with certain precautions; a donor of group B may give blood to a recipient of group B, or to a recipient of group AB with certain precautions; and a donor of group O may give blood to a recipient of group O, or to recipients of group A, B or AB with certain precautions (see table, column 6).

After this divergence I will take up the thread of my story again.

Blood transfusion was soon found to be such an important life-saving measure that in all civilized countries in the world blood transfusion services were started to provide blood, free or on payment, for patients who needed it. Such a service was started in Calcutta by Lieut.-Colonel R. B. Lloyd, the Imperial Serologist with the Government of India, about 15 years ago.

Blood transfusion is usually an emergency measure and the inevitable delay in obtaining a suitable donor will frequently be serious; the possibilities of obviating this delay were therefore explored. It was found that, if blood is taken under strictly aseptic conditions and kept in a cool place, it will retain all its therapeutic properties for at least ten days. Organizations were therefore set up for keeping a number of transfusion doses of blood of the various groups ready for immediate use. Such an organization was started in Calcutta a few years ago under the auspices of the Red Cross at the suggestion of Sir U. N. Brahmachari, the president of the Calcutta branch of the Red Cross Society, and was again run by the Imperial Serologist; this time Lieut.-Colonel Greval.

It was found in large centres that this worked very well in normal times, as the requirements could be estimated fairly accurately. But, at the beginning of this war, the blood transfusion services in England, anticipating a demand for blood, called up a number of volunteers and collected a large stock of blood against this possible demand; no air raids occurred in the early days of the war and much of this blood became time-expired and had to be discarded.

The idea of using serum or plasma in the place of whole blood was not a new one, and, as there seemed no means of prolonging the life of whole blood *in vitro* beyond the ten days, the possibilities of using the plasma removed from time-expired blood in the place of whole blood were further explored. Recent work has shown that, in many conditions, plasma or serum is quite as useful as whole blood, and, as they can be preserved for a considerably



longer time, for storage purposes plasma and serum replaced whole blood.

Plasma however has its limitations; it has to be kept at a very low temperature or changes occur, and though it can be stored for a much longer time than whole blood, this time is limited, so that again wastage is likely to occur. It was next found that if the moisture is removed from the plasma, by some process that does not entail denaturation of the serum protein, it can be preserved at atmospheric temperatures for a very much longer time than fluid plasma could be preserved in the refrigerator; such dried plasma can be redissolved in sterile distilled water wherever and whenever it is required for use. This last advance has opened up great possibilities as it has facilitated very considerably transport of plasma, and will probably in actual practice remove the time-limit for storage almost entirely; it is now possible to collect blood from anywhere in the world for use as plasma in any other part of the world.

Besides the advantages of easy preservation and rapid transport, serum or plasma has certain other very definite advantages.

Firstly, in conditions of shock without blood loss, there is a loss of plasma from the circulating blood into the tissues with a resultant concentration of the solid elements of the blood—the red cells; this interferes with the circulation. Giving whole blood does not relieve this state of affairs nearly as well as giving serum or plasma. Again, it is the loss of plasma protein from the circulation that is serious in shock, and, when reconstituting plasma from the powdered state, it is possible to make it hyper-concentrated, so that three or four times the amount of plasma proteins can be given in the same bulk.

Secondly, by using 'pooled' plasma or serum the need for blood grouping is obviated. By 'pooled' plasma, we mean plasma taken from the blood of a number of persons of different groups, that has been 'pooled' in a large vessel.

Let us consider what happens when blood is thus 'pooled'.

Say, for example, an A blood is mixed with a B blood; the  $\beta$  agglutinins in the A blood will act with the B agglutinogens in the B blood, the  $\alpha$  agglutinins in the B blood will act with the A agglutinogens in the A blood, and agglutination of the red cells will take place. As the red cells are not to be used this does not matter, but as the agglutinogens are stronger than the agglutinins all the latter will be absorbed and the plasma will be safe to give to a patient of any group.

The practical result of this introduction of dried plasma is that, in countries at present outside the war zone, America and Canada for example, blood banks have been started for collecting blood from which plasma is separated and dried to be sent to the theatres of war and to towns in Great Britain for air-raid casualties.

A scheme has recently been inaugurated under the auspices of the Government of India for collecting and drying plasma in India for use in the eastern theatres of war and amongst the civilian population in India in the event of air raids on our towns. An apparatus for drying plasma has been ordered from America and is expected in this country very soon. Before plasma can be dried, the blood from which it is to be separated must be obtained, and it is hoped that this blood will be obtainable on a voluntary basis.

The scheme for obtaining volunteers is being organized in conjunction with the existing Red Cross Blood Bank Committee which has been considerably enlarged for this purpose.

The present aims of the Calcutta scheme are relatively modest; we only expect to collect about 50 quarts of plasma a week. How modest this is, you will appreciate when you hear that in one blood bank in Moscow they collected three-quarters of a ton of blood a day. But we are only making a beginning and as time goes on we shall expand the organization in Calcutta and eventually carry it to other towns in Bengal.

That is briefly the history of blood transfusion in general, and of the present Blood Bank scheme in Calcutta.

I am not proposing to give you a lecture on the treatment of war wounds and air-raid casualties, but you all know that of those who are not killed outright, or so badly wounded that early death is inevitable, the very large majority of soldiers who die, die of shock. If the shock can be combated, the chance of saving the life of the wounded man—and in these days we must add woman or child—is very greatly improved. It is placing it at a low figure to say that the lives of 50 per cent of such persons who would otherwise have died can be saved by a blood or plasma transfusion given immediately.

Besides shock there are many other conditions in which blood or plasma transfusion is indicated. They are—

1. *After acute hæmorrhage.*—To make good loss sustained by an acute hæmorrhage, the transfusion of whole or citrated blood, either preserved or fresh, is the most effective. The amount to be transfused will be dependent on the amount lost, but anything less than 500 c.cm. is unlikely to be effective.

2. *As a prophylactic measure against shock.*—In weak or exsanguinated patients, even if their condition would not ordinarily demand transfusion, this is often a very valuable procedure to prepare them for a surgical or obstetric operation; blood or plasma is given according to the blood state of the patient.

3. *In anæmia.*—Blood transfusion is indicated to replace blood lost by hæmorrhage or destroyed by other processes, to maintain life in the case of splastic anæmia, and/or to

stimulate blood formation. Whole blood, citrated blood, or resuspended corpuscles can be used. In anæmia, repeated small transfusions of 300 to 400 c.cm. are usually better than a single big transfusion of, say, 1,000 c.cm.; in either case slow administration is to be recommended.

4. *For supplying other deficit elements, viz., platelets in thrombocytopenic purpura, leucocytes in agranulocytosis, or fibrin in some cases of clotting deficiency, transfusion of whole blood will sometimes be effective.*

5. *For counteracting toxins or increasing passive immunity.*—This is a procedure that was at one time in favour, particularly in America; the bloods of convalescents, or of others who had received injections in order to raise the antitoxic value of their blood, or to produce active immunity, were used as specific transfusions in certain cases. However, the new chemotherapeutic agents introduced in the last few years have put this procedure into the background.

Salines, glucose and gum solutions given intravenously may help temporarily in shock and some other conditions, but do not remain in the circulation in the same way that plasma or serum do, and collapse recurs. There is thus, in the treatment of shock, no true alternative to human blood products, and if lives are to be saved human blood must be obtained.

You must all know that the human organism is very elastic and has enormous reserves of all vital substances. For example, a large quantity of blood can be lost and yet by drawing on the immediate reserves the body will continue to function absolutely normally. The average blood donation for an adult is 500 c.cm., or about a pint; this amounts to one-tenth of the total blood volume, and represents about three days' normal manufacture of blood cells. The loss of this amount of blood has no physical ill-effect; in fact, it stimulates blood formation and will actually act as a tonic in many cases. Our forefathers appreciated the value of blood letting, but they abused it to such an extent that, like many other useful practices, it fell into disrepute. After giving a pint of blood, the inexperienced donor may feel some slight psychological effect, but actually it would be quite possible to play a hard game of tennis, though one would not recommend this practice. Most of you will be familiar with the operation of venepuncture and will know that it is an almost completely painless procedure.

Though the machine for drying plasma has not yet arrived, the blood bank in Calcutta has started operations for it was felt that it is quite time that we had a reserve of plasma or serum in our bank for our own needs in case of air raids, and it is possible to store serum in the fluid state for many months in a refrigerator. The main collecting centre for taking blood is at the All-India Institute of Hygiene, but,

wherever there are a large collection of volunteers, arrangements are made to send our collectors.

I do not know if there is any transfusion organization in Burdwan, but, if there is not, I put forward the suggestion that one should be started immediately. Burdwan as well as Calcutta is well within the war zone, and bombs may be dropped on us at any minute. Then you will want either blood or plasma for use amongst yourselves.

The organization that we have set up in Calcutta for collecting and drying blood is a comparatively expensive one and one would not advocate anything of this kind in Burdwan, but to collect plasma for pooling requires much less apparatus, and in fact can be done on a very modest scale with very inexpensive apparatus.

Perhaps what is even more important for a place like Burdwan is that you should have a list of volunteer donors ready for an emergency. These volunteers should have their blood groups ascertained and their Wassermann or Khan tests done, so that a suitable person of the right group can be chosen immediately and the time that would be absorbed in doing the preliminary grouping saved.

I am not here to beg you to volunteer as donors, for I believe that every medical man and student who understands the value of plasma to the injured will immediately demand to have his blood taken for the sake of his fellow men, and possibly for his own sake, for who amongst us can be certain that to-morrow he will not himself be an air-raid casualty. What I do ask you to do is to dispel some of the stupid traditions that have grown in the minds of laymen about blood donation, and to assure all your patients regarding the safety of the procedure.

The loss of a small amount of blood *does not* make a person weak, it *does not* make him an easy prey to infectious diseases, it *does not* make men impotent or women sterile.

Every person coming to give his or her blood should have a physical examination first, but minor degrees of ill-health are not contra-indications for giving blood. The faint-hearted say, 'I am already so anæmic that I cannot spare any blood'. You must reply, 'then, nothing could be better than a little blood-letting to stimulate your hæmopoietic system'. Others will say 'My blood is so poor that it wouldn't be any good to anyone'. You reply, 'If it is good enough for you who are walking about doing your day's work, it will be good enough to help a wounded man to tide him over a period of shock'. Others say, 'I would give my blood, but my mother, my husband, my wife won't let me'. Then you must tell them that their mothers, their husbands, their wives may be condemning them to die of shock, for if all mothers, all husbands and all wives took this attitude, there would be no plasma for the sons, the wives and the husbands who became victims in air raids. I cannot answer all the possible

objections that may be raised, but you, doctors and students, know the answers as well as I do, and there is always a good answer to these objections.

I will add just one piece of advice. If you can turn up your sleeve and say 'I gave my blood yesterday and it did me no harm' all your arguments will be much more convincing.

## Medical News

### ENHANCED ANTEDATE TO EMERGENCY COMMISSIONED OFFICERS OF THE INDIAN MEDICAL SERVICE

Some weeks ago the Government of India intimated the concession of gratuities on a greatly enhanced basis to certain groups of emergency commissioned officers of the Indian Medical Service.

Government now announces a further important war-time concession which makes employment in the Indian Medical Service for the period of the present emergency highly attractive. It has been decided to give an antedate, based on professional experience, to emergency commissioned officers of the I.M.S. This antedate, which is limited to 5 years, will be reckoned on the basis of half the number of completed years from the date of medical qualification to the date of appointment to the I.M.S. Thus ten years spent in active practice of the medical profession will qualify for the maximum of 5 years antedate, 6 years in practice for 3 years antedate and 3 years in practice for 18 months. Antedate will not be reckoned in periods of less than 6 months and the minimum antedate to be granted will be one year, earned by two years' medical practice.

This concession will be in addition to any antedate which may be admissible to an officer of the service on account of special post-graduate qualifications and specified hospital appointments, except that a period spent in hospital appointments will not count twice in reckoning the total antedate admissible. The whole period of antedate which an officer may obtain will count for pay and promotion on the time scale and for seniority in the service.

### APPROVED BADGE FOR AUXILIARY NURSING SERVICE

Her Excellency the Marchioness of Linlithgow, President of the newly constituted Auxiliary Nursing Service, has approved a badge for use in the Service.

The badge is circular in shape and is of the same size as the badge of the St. John Ambulance Association. A map of India with a star inset is embossed on one side with the words 'Auxiliary Nursing Service' around the margin and serial number is engraved on the reverse.

The badge is being made by His Majesty's Mint in Bombay in silver-plated cupro-nickel. Every registered member of the Service will be provided with the badge which will remain the property of the Government.

### GREATER RESTRICTION ON IMPORTED MEDICAL STORES PROBABLE

It is probable that with the progress of the war there will be much greater restriction on the import of drugs and other medical stores into India from the United Kingdom and America.

To enable the Government of India to deal expeditiously with any situation which might arise from restricted imports, a circular letter has been addressed to the principal importers of medical stores asking them to state the names of items imported during 1940 with the quantities.

This information is essential in order that the Government may obtain the co-operation of the United Kingdom and America and the Eastern Group countries in obtaining regular supplies of essential drugs and other medical stores for India.

Importing firms are required to submit to the Director-General, Indian Medical Service, New Delhi, a statement of their imports of drugs during 1940 stating against each item the quantity imported, customs declaration number and the country of origin.

### SURGICAL AND ORTHOPÆDIC INSTRUMENTS

INDIA is now a predominant instrument producer among the Eastern Group countries and practically 100 per cent of hospital and operation theatre equipment and 98 per cent of orthopædic instruments and appliances are now produced by the Indian industries.

Planning is in progress for the production during the next twelve months of five million instruments and appliances by the Indian surgical instruments industry.

The purchase of surgical dressings and bandages by the Medical Stores Department has assumed almost astronomical proportions. In one indent alone about 6,700 miles of textiles were converted into bandages. The production capacity of India of cotton-wool is approximately 120,000 lb. per month and that of lint about 16,000 lb. per month.

First field dressings are being manufactured in large numbers in the factories of the Medical Stores Department and also by private firms. In the Madras Medical Store Depot the shell dressing factory is manufacturing nearly 1,000,000 shell dressings per month.

Scientific and medical glassware and neutral glass required for sterile solutions for injection purposes are also now being successfully produced in India.

The manufacture of rubber goods in India has been for many years encouraged by the Medical Stores Department. Good quality waterproof sheeting, hot water bottles and other articles required in rubber have been made in India for some time. Since the outbreak of the war, the number of items required in rubber made in India has greatly increased.

### RECRUITMENT OF WOMEN MEDICAL GRADUATES TO THE INDIAN MEDICAL SERVICE FOR THE DURATION OF PRESENT EMERGENCY

THE Government of India have decided to recruit for the duration of the present emergency a limited number of women medical graduates to the Indian Medical Service with full liability for general service in and out of India. At present lady doctors having experience in oto-rhino-laryngology, radiology, pathology, ophthalmology or anaesthetics will be recruited. Recruitment will be open to both Indians and Europeans below the age of 45.

Women graduates will be appointed as 'medical officers' with the relative rank of Lieutenant in the Indian Medical Service and will be granted further advancement in rank like other Emergency Commissioned Officers of the Indian Medical Service. Pay will be the same as paid to men in the Indian Medical Service.

Detailed terms and conditions of service will be announced shortly.

## ANTEDATE FOR I.M.D. OFFICERS

### FURTHER WAR-TIME CONCESSION ANNOUNCED

A FURTHER war-time concession in the Emergency Branch of the Indian Medical Department is announced by the Government of India. It is the grant of an antedate based on professional experience.

Some weeks ago the Government announced the concession relating to increase in the emoluments of Assistant Surgeons of the Emergency Branch of the Indian Medical Department. It has now been decided to give also an antedate, based on professional experience, to those Assistant Surgeons (India Cadre) who, prior to appointment to the Emergency Branch, have been in the practice of their profession for over three years.

The antedate, which is limited to five years, will be reckoned on the basis of half the number of completed years of their medical practice. Thus ten years spent in active practice will qualify for the maximum of five years' antedate; six years in practice for three years' antedate and so on. Antedate will not be reckoned in periods of less than six months.

In addition, an Assistant Surgeon (India Cadre) who at the time of his selection is in possession of a higher qualification, such as M.C.P. & S., M.M.F., M.S.M.F., and D.M. & S. or an equivalent post-licentiate qualification, may be granted an antedate not exceeding 12 months.

An antedate not exceeding six months may also be granted to an Assistant Surgeon who possesses a Diploma in Tropical Medicine, or a qualification which is recognized as equivalent in all respects to the above-mentioned qualification.

The whole period of antedate which an officer may obtain will in future count for increments of pay and seniority in the Service.

## 'NEED TO EDUCATE THE EDUCATED'

### DR. AYKROYD ON IMPROVEMENT OF DIET IN INDIA

'ONE of the tasks of those who are striving to improve diet in India is to educate the educated', writes Dr. W. R. Aykroyd, Director of the Nutrition Research Laboratories, Coonoor, in the third edition of Health Bulletin No. 23, entitled 'The Nutritive Value of Indian Foods and the Planning of Satisfactory Diets'.

Dr. Aykroyd continues: It is not only the poor, whose choice in the matter of food is extremely limited, who are ignorant and prejudiced about diet suffer in health because of it. Plenty of people in India and elsewhere, who could afford to consume an excellent diet, and feed their children on an excellent diet, do not in fact do so. One can readily find among children of the more prosperous classes cases of serious malnutrition and food-deficiency disease.

Those who suffer from under and malnutrition usually cannot afford to purchase a satisfactory diet. Many residential institutions for children in India are very short of money, and have often to feed their boarders on Rs. 3 per head per month, or a good deal less. Now it is difficult, in fact impossible, to supply a really satisfactory diet for such sums.

### Value of milk

But even when poverty prevents the purchase of a diet which satisfies modern standards of nutrition, it is often possible to make effective improvements with little increase in cost.

It is desirable that children should consume upwards of 8 oz. of milk a day—8 oz. being an amount below that recommended as 'optimum' by nutrition workers elsewhere. If available funds do not admit the addition of this quantity of whole milk, butter-milk or skimmed milk, reconstituted from skimmed milk powder, may be supplied. *Even a little milk is better than none.*

Careful experiments have shown that the giving of 8 oz. of skimmed milk daily to children fed on an

average 'ill-balanced' Indian diet results in an acceleration of growth and a great improvement in health and well-being. Such an addition is not very costly, and is now being supplied in a considerable number of children's homes in India, to the great benefit of the children.

Calcium is found abundantly in milk (including skimmed milk and butter-milk), cheese and green leafy vegetables. Amaranth, fenugreek and drumstick leaves are rich in calcium. Children need relatively more calcium and other minerals than adults, just as they need relatively more protein. Rice is very deficient in calcium, and there is evidence that insufficiency of calcium is one of the most important defects of the rice eater's diet.

### Parboiled rice

If the cereal consumed is milled rice, an improvement in the nutritive value of the diet (and in the health of those consuming it) can be brought about by wholly or partially substituting whole rice, whole wheat or one of the millets, particularly ragi.

If milled rice remains the basis of the diet, it should be realized that the milled-rice eater needs more 'protective' foods—milk, green vegetables, fruits, etc.—than the consumer of whole wheat or ragi. When the diet is almost wholly composed of rice—when people are so poor that they cannot afford to buy other foods except in minute quantities—then the state in which the rice is eaten becomes of paramount importance. Parboiled rice, even when milled, is superior in nutritive value (particularly as regards the anti-beri-beri vitamin) to raw rice milled to the same degree.

Diets in children's homes, and among the general population, are often low in fat. Addition of extra vegetable oil (at the expense of a quantity of cereal supplying an equivalent number of calories) does not greatly increase expenditure. Pure ghee or butter is, of course, preferable to vegetable fat, but very much dearer.

Pulses are rich in protein and in some of the B vitamins; 2 to 3 oz. per day increase the nutritive value of a diet largely composed of cereals. However, the pulses in general are less valuable dietary supplements than animal foods such as milk, fish and meat.

### Groundnuts

More use could perhaps be made of groundnuts, which are rich in various food-factors, including some of the B vitamins, as human food. Half to one ounce daily helps to supply some of the elements in which poor rice diets are deficient.

Fruits should always be included in children's diets. Plantains, a cheap fruit often supplied in hostels, are good food but not of exceptionally high nutritive value. Tomatoes and oranges and other 'juicy' fruits are richer in vitamins and make a useful addition to diets of the poorer type.

### Manufactured vitamins

Daily doses of iron or calcium lactate may have an excellent effect. Within recent years, the chemical composition of a number of vitamins has been discovered and some of them can now be manufactured cheaply and in large quantities. Vitamins produced in this way are just as valuable to the body as vitamins contained in foods.

Further developments in research or industry may make it possible to produce many vitamins in pure form at so low a cost as to make their widespread use in improving poor Indian diets a feasible proposition. This stage has not yet been reached, and meanwhile it is necessary to rely chiefly on suitable combinations of ordinary foods in devising improved diets.

But the idea of giving malnourished children a daily capsule containing more than their requirements of the various essential vitamins in concentrated form is not so outlandish as it seems.

In England, pure vitamin B, made in a factory, is being added to bread made from refined wheat flour to bring its nutritive value nearer to that of wholemeal bread. In America also, great interest is being taken in the possibility of 'fortifying' foods and diets by means of cheap manufactured vitamin preparations. The uninterrupted development of scientific research for a few decades may produce the most striking and unexpected results in this direction.

#### RESEARCH INTO IMPROVEMENT OF POTATO CROP

THE principal recommendations and conclusions of the Agricultural Marketing Adviser to the Government of India on the growing and marketing of potatoes are summarized in a convenient form in an abridged version of the Report on the Marketing of Potatoes in India and Burma.

Potatoes are an important money crop, the annual production being worth about Rs. 9,50,000. There has been a steady increase in acreage during the last ten years, but India still imports on an average more than a million maunds of potatoes a year. These large imports indicate the scope for increasing the area under potatoes, particularly in the hills.

The Agricultural Marketing Adviser recommends that more research should be undertaken with a view to improving the quality and yield and that arrangements should be made for the organization of seed supplies and credit to cultivators for the purchase of seed and manure. The grading of potatoes, he holds, is absolutely essential, while market practices should be standardized and market charges fixed. Every encouragement, he suggests, should be given to the formation of co-operative sale societies; the cost of distribution should be reduced by eliminating intermediaries as far as possible, charges for transport of potatoes by rail should be reduced and additional facilities should be provided for storing and marketing potatoes at terminal stations.

Potatoes cannot be successfully grown in the plains during the summer. The Agricultural Marketing Adviser recommends that the surplus produce of the main crop in the plains should be kept in cold-storage and released during periods of scarcity; or, as an alternative, the growing of larger quantities of potatoes in the hills should be taken up.

#### VITAMIN WHICH PREVENTS SCURVY USES OF 'AMLA'

VITAMIN C or ascorbic acid, the vitamin which prevents scurvy, is found in fresh fruits and vegetables. Among vegetables, the green leafy varieties are the best sources.

Pulses and cereal grains in the ordinary state contain no vitamin C. When, however, they are allowed to sprout, the vitamin is formed in the grain and in the growing green sprouts.

There is one cheap and common fruit, namely, *amla* or *nellikai* (*Phyllanthus emblica* Linn), which is probably the richest natural source of vitamin C. *Amla* (gooseberry) grows abundantly in all Indian forests and is obtainable in almost unlimited quantities from January to April. The fresh juice contains nearly twenty times as much vitamin C as orange juice, and a single fruit is equivalent in vitamin C content to one or two oranges.

The heating or drying of fresh fruits or vegetables usually leads to the destruction of most or all the vitamin C originally present. *Amla* is an exception among fruits because of its high initial vitamin C content, because it contains substances which practically protect the vitamin from destruction on heating and drying, and because its juice is strongly acid. Acidity has a protective action on vitamin C. Hence it is possible to preserve *amla* without losing much of the vitamin.

*Amla* is included as an ingredient in many Ayurvedic medicines and tonics. Fresh *amla* was found to be a most effective cure for scurvy when an outbreak of the disease occurred in 1940 in the Hissar famine area. Tablets made from *amla* powder contain vitamin C in concentrated form and this is a convenient method of preserving this vitamin for future use.

#### REPORT OF THE LEPROSY SURVEY SUB-COMMITTEE OF THE INDIAN RESEARCH FUND ASSOCIATION

THIS report is headed Leprosy Surveys; objects, methods and interpretation of findings. The reason for the appointment of this committee and the general lines of the report are stated in the introduction:—

'Recent survey work in other countries and in India has indicated the occurrence of considerable variations in leprosy, particularly in the age-distribution and in the type-distribution of the cases (that is, proportion of the cases belonging to the two main groups, neural and lepromatous). It has become clear that these two factors, and probably also other factors, are of considerable importance as indications of the seriousness or otherwise of the leprosy problem, and that mere enumeration of the cases is of limited value.

It is therefore important that leprosy surveys should be carried out according to a more or less uniform plan which will provide for the collection of data covering the points mentioned above. If this is done it should be possible to compare the leprosy survey findings in different parts of the country and thus form a truer picture of the leprosy problem of India.

The ground covered by this report is indicated by the title "Leprosy Surveys; objects, methods and interpretation of findings". The report not only deals with the principles of leprosy survey, but also with the actual practical details of the work. The report is based on practical experience of leprosy survey work in various parts of India over a number of years.'

The different sections of the report deal with the following subjects:—the objects and types of survey (three types of survey are outlined); general notes on survey methods; survey units; staff, etc.; outlines of the three different types of survey methods used, the selection of the area for survey, and the records and reports of the survey; the analysis and interpretation of the survey findings; re-survey of previously surveyed areas; and the making of recommendations for anti-leprosy work based on survey findings. The appendices include notes on clinical manifestations of leprosy and classification of cases, on diagnosis and bacteriological examination.

The report succeeds in doing what it sets out to do, namely, to discuss the principles and practice of leprosy surveys and to outline methods of work and of presentation of reports which, with minor modifications, should be applicable to most, if not all, parts of the country. The general adoption of the methods outlined in this report would greatly facilitate the collection of accurate information about leprosy, and a comparison between the leprosy problem of one part of the country and another.

The report should be of great value to workers undertaking leprosy surveys for the first time; it contains suggestions and ideas which should be of interest and value even to the experienced survey worker. This report, we are informed, is being circulated to the different provinces of India in the hope that future surveys in these provinces will be carried out along the lines outlined. Copies of the report can be obtained from the Indian Research Fund Association, New Delhi, or from the Indian Council of the British Empire Leprosy Relief Association, New Delhi.

The committee, which consisted of Doctors Lowe, Dharmendra and Santra, are to be congratulated on the valuable report that they have produced. They are also lucky in having their report printed by a good press so that it is not mutilated by the printer, as are many of the best Indian Government reports.

## Public Health Section

A MALARIO-ECONOMIC SURVEY IN  
RURAL SOUTH INDIA\*By PAUL F. RUSSELL  
and

M. KUMARA MENON

*Introduction*

THIS paper reports a malario-economic survey made by a house-to-house canvass in three malarious and two non-malarious villages in south-eastern Madras between March 1939 and March 1940. The survey was undertaken in order to obtain some understanding of economic and social conditions with particular reference to malaria and its control. The malarious villages included were Kasangadu, Tuvarangurichchi, and Senjayakollai in Pattukkottai taluk of Tanjore District. The non-malarious villages were Ichchangudi and Someswarapuram, typical delta areas in Papanasam taluk, also in Tanjore District. In Pattukkottai taluk, the Cauvery-Mettur canal irrigation project opened in 1933-34, has brought malaria as a by-product into an area previously free from this disease. In Papanasam taluk there has been irrigation for centuries from canals taking off directly from the Cauvery river. There is no record of malaria in this area and no evidence of its presence to-day.

Since 1936, investigations into the epidemiology and control of malaria in Pattukkottai taluk have been proceeding and a number of reports have been published (Russell, Menon and Rao, 1938; Russell, 1938; Russell, Sweet and Menon, 1939; Russell and Rao, 1940). It now seems clear that malaria in Pattukkottai taluk is transmitted principally by *Anopheles culicifacies*, that it dates from 1933-34, and that it is largely due to type of construction of irrigation canals, distributors, and sluice gates, and to the way in which the water is being manipulated both by engineers and ryots. Malaria in this area illustrates what may happen where there is a lack of co-ordination between agriculture, public works and health departments.

*Procedure*

The surveys were made by two medical officers, who went from home to home seeking information. Sufficient time was allotted so that data could be extracted carefully and intelligently from the people. In Kasangadu, and also

in Tuvarangurichchi, one of the medical officers took up residence. For surveying the other villages the medical officers resided nearby. In all five villages they became well acquainted with the inhabitants, treating minor illnesses and gaining full confidence. Repeated visits to some houses were necessary. As far as possible, all data were checked. Figures 1 and 2 illustrate the type of survey card used. The following instructions as to the use of the survey card were given :—

*Instructions regarding use of village survey cards*

Survey cards are numbered at office.

Houses are numbered by officer conducting survey.

Head of house: refers to chief man living in the house.

Owner: may be other than head of house.

Type of house: mud, thatch, tile, brick, plaster. Brick refers only to burnt brick.

Number of rooms (porches are not counted as rooms).

Humans only: means that no animals were stabled under same roof at night.

Mixed dwelling: means that animals were stabled under same roof at night.

Def. separate: means that animals were under same roof but separated from sleeping persons by a wall.

Floor space and cubic space estimated.

Value: means estimated replacement value.

Religion: Hindu, Moslem, Christian.

Caste: Brahmins, Caste Hindus other than Brahmins, and Harijans (i.e., Hindus without caste, 'untouchables' or 'depressed classes').

Sleeping no.: number of persons usually sleeping in house or on porch.

Wells: report whether sanitary or not, excluding wells used strictly for irrigation.

Screens: refers to wire screen cloth on windows or doors.

Bed-nets: refers to cloth mosquito curtains used at night.

Ann. income: record in rupees after careful questioning. Joint family income in money and produce included. Figure is estimated *total* income for year. Income may include receipts from lands or business situated outside the villages.

Govt. tax: includes land and water taxes. This tax goes to Madras Government and is paid by ryots directly to Government agents. Includes taxes on lands that may be outside the village but owned by the ryots of the village.

Local tax: non-Government taxes paid to zemindars or inamdars. This is primarily a land rent.

Interest: refers to interest payments for debts.

\* This paper is based on observations made as a part of the programme of Malaria Investigations, a project under the auspices and having the support of the International Health Division of the Rockefeller Foundation, co-operating with the Health Department of Madras Presidency and the Pasteur Institute of Southern India, in Coonoor. The authors are grateful to Dr. V. P. Jacob and Mr. T. Ramachandra Rao, of the staff of Malaria Investigations, for their assistance.



Paid treat. fevers : includes so far as possible only the fevers of malaria, as judged by typical

Births and deaths : refers to habitual residents of given house. Cause of death diagnosed

**MALARIA INVESTIGATIONS - KING INSTITUTE - MADRAS** Village Survey Card No.....

Village \_\_\_\_\_ Date \_\_\_\_\_ Map Square.....

House No. \_\_\_\_\_ Street : \_\_\_\_\_

Head of House \_\_\_\_\_ Owner \_\_\_\_\_

Head Occupation \_\_\_\_\_ Owner's Res. \_\_\_\_\_

Type of House \_\_\_\_\_ Land owned \_\_\_\_\_ Ann. Income \_\_\_\_\_

No. of Rooms \_\_\_\_\_ Lands on Lease \_\_\_\_\_ Rent Paid \_\_\_\_\_

Humans only \_\_\_\_\_ Religion \_\_\_\_\_ Govt. Tax \_\_\_\_\_

M Mixed Dwelling \_\_\_\_\_ Caste \_\_\_\_\_ Local Tax \_\_\_\_\_

I D Def. Separate \_\_\_\_\_ Sleeping No. \_\_\_\_\_ Interest \_\_\_\_\_

S A Floor Space \_\_\_\_\_ Latrine \_\_\_\_\_ Total Debts \_\_\_\_\_

C T Cubic Space \_\_\_\_\_ Well \_\_\_\_\_ Paid Treat. Fevers \_\_\_\_\_

A Value \_\_\_\_\_ Screens \_\_\_\_\_ Days Lost \_\_\_\_\_

Bed Nets \_\_\_\_\_ Wages \_\_\_\_\_

S  
T  
A  
T  
I  
S  
T  
I  
C  
S  
  
V  
I  
T  
A  
L

| Year | Births |        | Deaths |       |
|------|--------|--------|--------|-------|
|      | No.    | Normal | No.    | Cause |
| 1937 |        |        |        |       |
| 1938 |        |        |        |       |
| 1939 |        |        |        |       |
| 1940 |        |        |        |       |
| 1941 |        |        |        |       |
| 1942 |        |        |        |       |
| 1943 |        |        |        |       |

Remarks : (Malaya, etc.)

A  
N  
I  
M  
A  
L  
  
G  
E  
N  
S  
U  
S

| Species   | In House | Around House | Total Owned |
|-----------|----------|--------------|-------------|
| Asses     |          |              |             |
| Buffaloes |          |              |             |
| Bullocks  |          |              |             |
| Cats      |          |              |             |
| Dogs      |          |              |             |
| Fowl      |          |              |             |
| Goats     |          |              |             |
| Horses    |          |              |             |
| Sheep     |          |              |             |
| Swine     |          |              |             |
| Others    |          |              |             |

**OCCUPANTS**

|   | Name | Relation | Sex | Age | Remarks |
|---|------|----------|-----|-----|---------|
| a |      |          |     |     |         |
| b |      |          |     |     |         |
| c |      |          |     |     |         |
| d |      |          |     |     |         |
| e |      |          |     |     |         |
| f |      |          |     |     |         |
| g |      |          |     |     |         |
| h |      |          |     |     |         |
| i |      |          |     |     |         |
| j |      |          |     |     |         |
| k |      |          |     |     |         |
| l |      |          |     |     |         |
| m |      |          |     |     |         |
| n |      |          |     |     |         |
| o |      |          |     |     |         |
| p |      |          |     |     |         |
| q |      |          |     |     |         |

Fig. 1.

symptoms. Includes payments to doctors, quacks, and priests, cost of drugs, sacrifices, and special food.

Days lost : refers only to malaria.

Wages lost : refers only to malaria.

by careful questioning by medical officers making survey.

Remarks (Malaya, etc.) : refers to such matters as recent immigration from Malaya, where some of local residents have been employed

on rubber estates, frequently in malarious areas.

Animal census: 'in house' refers to animals stabled under roof of house at night. 'Around house' may mean anywhere in village, but owned by occupants of the house.

Occupants: list begins with chief occupant, and all relationships are in reference to him. Casual visitors not counted, but guests of three months' residence and servants are included.

some attention is being paid nowadays, formed a fair proportion of all the four Hindu villages.

2. *Housing and living conditions.*—In table II are given details in respect of houses and related conditions. The houses were predominantly of the mud-wall and thatched-roof variety, but in the delta villages brick and tiled houses were more usual. The average number of rooms per house varied from 1.4 to 2.5 in the five communities, and density of population varied from

#### Spleen and Blood Examinations

| Dates | Spl. | Sm. | Spl. | Sm. | Spl. | Sm. | Spl. | Sm. | Spl. | Sm. | Spl. | Sm. | Spl. | Sm. | Spl. | Sm. | Spl. | Sm. |
|-------|------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|
| a     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| b     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| c     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| d     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| e     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| f     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| g     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| h     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| i     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| j     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| k     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| l     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| m     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| n     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| o     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| p     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |
| q     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |      |     |

REMARKS:

Fig. 2.

#### Findings

1. *Population.*—In table I are given population statistics of the five villages surveyed. It will be noted that the greatest population (1,684) was in Kasangadu and the smallest in Senjayakollai (557). These figures refer to actual population as enumerated at time of survey and are not from the official 1931 census. Distribution by sex was fairly equal, each village having a few more females than males, the excess working out to an average of 25.4 per mille of men. As regards age distribution the following percentages for age groups under one year and over 50 years were obtained:—

| Place                  | Under 1 year | Over 50 years |
|------------------------|--------------|---------------|
| Kasangadu .. ..        | 3.0          | 9.4           |
| Tuvarangurichchi .. .. | 3.3          | 10.7          |
| Senjayakollai .. ..    | 1.1          | 6.5           |
| Ichchangudi .. ..      | 4.6          | 11.5          |
| Someswarapuram .. ..   | 3.2          | 13.5          |

It will be noted (table I) that Senjayakollai was largely a Christian village, the others principally Hindu. Few Muslims were living in any of the villages surveyed. Harijans (depressed classes), towards whose betterment

4.7 in Ichchangudi to 10.5 Senjayakollai. As will be seen from the table, Senjayakollai houses were considerably larger than those in the other villages, as regards average floor space per house. None of the houses was screened against mosquitoes or other insects; and only 16 persons used bed-nets. No constructed latrines of any sort were found.

Mixed dwellings, i.e., those dwellings in which men and animals were housed under the same roof, were very common. In table III are given particulars of numbers and types of animals found in the villages. Bullocks, goats, fowls, and buffaloes were most common. Relatively more animals were stabled in human dwellings at night in the delta villages than in Pattukottai taluk. Excluding fowls, the number of animals per person varied from 1.3 in Tuvarangurichchi to 0.4 in Senjayakollai.

There was nothing in the data from the animal census to suggest zooprophylaxis. The highest number of bullocks and buffaloes *per capita* was in Senjayakollai, one of the malarious villages. The lowest number, 0.4, was in the non-malarious village of Ichchangudi.

Clothing was comparatively meagre, males usually wearing only a loin cloth. Females generally had a long saree, the greater length of which was worn around the body from waist

down, the remaining portion being draped over the shoulders and chest.

The staple diet of the ryots was rice supplemented by millets and some vegetables. Meat

TABLE I

*Population statistics in villages of economic survey, 1939-40\**

| Population                   | PATTUKKOTTAI TALUK |                   |               | TANJORE DELTA |                 |
|------------------------------|--------------------|-------------------|---------------|---------------|-----------------|
|                              | Kasangadu          | Tuvaran-gurichchi | Senjayakollai | Ichchangudi   | Someswara-puram |
| Totals .. ..                 | 1,684              | 1,381             | 557           | 954           | 690             |
| Males .. ..                  | 824                | 686               | 276           | 475           | 339             |
| Females .. ..                | 860                | 695               | 281           | 479           | 351             |
| Age groups { 0-1 year .. ..  | 51                 | 46                | 6             | 43            | 22              |
| 1-5 years .. ..              | 186                | 157               | 56            | 106           | 90              |
| 6-12 " .. ..                 | 341                | 277               | 146           | 165           | 95              |
| 13-21 " .. ..                | 252                | 210               | 103           | 121           | 79              |
| 22-50 " .. ..                | 695                | 542               | 210           | 409           | 311             |
| Over 50 " .. ..              | 159                | 149               | 36            | 110           | 93              |
| Non-Brahmin caste, Hindus .. | 1,474              | 1,230             | 15            | 514           | 410             |
| Harijans .. ..               | 170                | 123               | 11            | 219           | 264             |
| Brahmins .. ..               | 13                 | 21                | ..            | 138           | 7               |
| Total Hindus .. ..           | 1,657              | 1,374             | 26            | 871           | 681             |
| Muslims .. ..                | 4                  | 6                 | 0             | 0             | 9               |
| Christians .. ..             | 23                 | 1                 | 531           | 83            | 0               |

\* The figures were obtained in a house-to-house census by two medical officers of the staff of Malaria Investigations.

TABLE II

*Housing statistics in villages of economic survey, 1939-40\*†*

| Classification                                       | PATTUKKOTTAI TALUK |                   |               | TANJORE DELTA |                 |
|--|--------------------|-------------------|---------------|---------------|-----------------|
|  | Kasangadu          | Tuvaran-gurichchi | Senjayakollai | Ichchangudi   | Someswara-puram |
| Thatched houses .. ..                                | 309                | 277               | 50            | 165           | 73              |
| Tiled houses .. ..                                   | 13                 | 9                 | 3             | 38            | 53              |
| Total houses .. ..                                   | 322                | 286               | 53            | 203           | 126             |
| Total rooms .. ..                                    | 453                | 434               | 133           | 379           | 315             |
| Average number of rooms per house.                   | 1.4                | 1.5               | 2.5           | 1.9           | 2.5             |
| Total floor space (sq. ft.) ..                       | 224,935            | 100,965           | 79,714        | 88,553        | 74,326          |
| Average floor space per house (sq. ft.).             | 698.6              | 352.0             | 1,502         | 436.2         | 589.5           |
| Total cubic size (cu. ft.) ..                        | 3,845,739          | 1,772,711         | 1,200,510     | 1,317,191     | 1,261,581       |
| Average cubic size (cu. ft.) ..                      | 11,943             | 6,197.5           | 22,651        | 6,488.6       | 10,012.5        |
| Average cubic space per individual person (cu. ft.). | 2,283.6            | 1,283.7           | 2,155         | 1,380.7       | 1,828.4         |
| Average inhabitants per house ..                     | 5.2                | 4.8               | 10.5          | 4.7           | 5.5             |
| Dwellings solely for humans ..                       | 120                | 126               | 36            | 107           | 59              |
| Mixed dwellings for humans and animals.              | 202                | 160               | 17            | 96            | 67              |
| Number of wells .. ..                                | 173                | 129               | 7             | 43            | 21              |
| Average persons per well .. ..                       | 10                 | 11                | 80            | 22            | 33              |
| Bed-nets used .. ..                                  | 4                  | 1                 | 0             | 10            | 1               |
| Value of inhabited houses in Rs.‡ { Total .. ..      | 43,176             | 22,467            | 15,290        | 27,459        | 37,396          |
| Average per house.                                   | 134/2              | 78/8              | 288/10        | 135/3         | 299/3           |

\* Figures were obtained by house-to-house census.

† There are no sanitary latrines in any of these villages.

‡ An Indian rupee is now equivalent to £0-1-6 or U.S. \$0.32. There are 16 annas in a rupee and 12 pies in one anna.

TABLE III  
*Animal census in villages of economic survey, 1939-40\**

| Classification                  |                 | PATTUKKOTTAI TALUK |                   |               | TANJORE DELTA |                 |
|---------------------------------|-----------------|--------------------|-------------------|---------------|---------------|-----------------|
|                                 |                 | Kasangadu          | Tuvaran-gurichchi | Senjayakollai | Ichchangudi   | Someswara-puram |
| Asses                           | In house† ..    | 0                  | 0                 | 0             | 0             | 0               |
|                                 | Around house    | 12                 | 0                 | 0             | 0             | 1               |
|                                 | Totals* ..      | 12                 | 0                 | 0             | 0             | 1               |
| Buffaloes                       | In house ..     | 8                  | 22                | 16            | 96            | 77              |
|                                 | Around house    | 217                | 50                | 21            | 57            | 129             |
|                                 | Totals ..       | 225                | 72                | 37            | 153           | 206             |
| Bullocks                        | In house ..     | 174                | 280               | 107           | 189           | 122             |
|                                 | Around house    | 652                | 455               | 274           | 81            | 170             |
|                                 | Totals ..       | 826                | 735               | 381           | 270           | 292             |
| Cats                            | In house ..     | 3                  | 9                 | 7             | 0             | 0               |
|                                 | Around house    | 3                  | 0                 | 0             | 0             | 0               |
|                                 | Totals ..       | 6                  | 9                 | 7             | 0             | 0               |
| Dogs                            | In house ..     | 0                  | 0                 | 9             | 9             | 4               |
|                                 | Around house    | 38                 | 83                | 20            | 0             | 0               |
|                                 | Totals ..       | 38                 | 83                | 29            | 9             | 4               |
| Fowl or doves                   | In house ..     | 5                  | 0                 | 104           | 48            | 0               |
|                                 | Around house    | 463                | 626               | 251           | 146           | 98              |
|                                 | Totals ..       | 468                | 626               | 355           | 194           | 98              |
| Gonats                          | In house ..     | 472                | 440               | 85            | 106           | 109             |
|                                 | Around house    | 137                | 140               | 87            | 16            | 9               |
|                                 | Totals ..       | 609                | 580               | 172           | 122           | 118             |
| Sheep                           | In house ..     | 15                 | 25                | 6             | 0             | 0               |
|                                 | Around house    | 19                 | 296               | 213           | 0             | 0               |
|                                 | Totals ..       | 34                 | 321               | 219           | 0             | 0               |
| Others                          | In house ..     | 0                  | 0                 | 0             | 0             | 0               |
|                                 | Around house    | 0                  | 0                 | 0             | 0             | 0               |
|                                 | Totals ..       | 0                  | 0                 | 0             | 0             | 0               |
| Totals includ-<br>ing fowls.    | In house ..     | 677                | 776               | 334           | 448           | 312             |
|                                 | Around house    | 1,541              | 1,650             | 866           | 300           | 407             |
|                                 | Totals ..       | 2,218              | 2,426             | 1,200         | 748           | 719             |
| Totals exclud-<br>ing fowl.     | In house ..     | 677                | 776               | 230           | 448           | 312             |
|                                 | Around house    | 1,078              | 1,024             | 615           | 154           | 309             |
|                                 | Totals ..       | 1,755              | 1,800             | 845           | 602           | 621             |
| Animals (ex-<br>cluding fowl).  | Per dwelling    | 5.5                | 6.3               | 4.1           | 3.0           | 4.9             |
|                                 | for humans.     |                    |                   |               |               |                 |
|                                 | Per person ..   | 1.0                | 1.3               | 0.4           | 0.6           | 0.9             |
| Buffaloes and<br>bullocks only. | Per dwelling .. | 3.3                | 2.8               | 7.7           | 2.1           | 4.0             |
|                                 | Per person ..   | 0.6                | 0.6               | 1.5           | 0.4           | 0.7             |

\* Figures were obtained by house-to-house census.

† The figures for animals 'in house' refer to animals stabled under the same roof with humans at night.

The figures for total animals refer to all which are usually kept somewhere in the village area.

and fish entered only as an occasional factor in their dietary, as such items were costlier than vegetables.

Expenses for lighting were fairly low. A few homes possessed small kerosene lamps, used for a few hours in the evening, but the majority of houses had no lights at all.

3. *Occupations*.—Occupations of the head of families are given in table IV. The group of farmers was largest for all of the villages surveyed except Ichchangudi where labourers

predominated and where there was a relatively large number of landlords. The labour there, however, was chiefly agricultural.

4. *Property and income*.—Table V deals with land holdings in the villages and also with income. The average land holding per person varied from 0.19 acre in Ichchangudi to 0.91 acre in Senjayakollai. Income per house from all sources varied from Rs. 345-8-0 in Senjayakollai to Rs. 151-0-0 in Kasangadu. The *per capita* income ranged from Rs. 29-0-0 in Kasangadu to

TABLE IV  
Occupation statistics in villages of economic survey, 1939-40\*

| Classification             | PATTUKKOTTAI TALUK |                   |               | TANJORE DELTA |                 |
|----------------------------|--------------------|-------------------|---------------|---------------|-----------------|
|                            | Kasangadu          | Tuvaran-gurichchi | Senjayakollai | Ichchangudi   | Someswara-puram |
| Actor .. ..                | 8                  | ..                | ..            | ..            | ..              |
| Barber .. ..               | 2                  | 7                 | 1             | 2             | 2               |
| Binder .. ..               | ..                 | 1                 | ..            | ..            | ..              |
| Blacksmith .. ..           | 3                  | 1                 | ..            | 1             | ..              |
| Butcher .. ..              | ..                 | 1                 | ..            | ..            | ..              |
| Carpenter .. ..            | 5                  | 1                 | 2             | 3             | 2               |
| Cart driver .. ..          | ..                 | ..                | ..            | 3             | ..              |
| Church peon .. ..          | ..                 | ..                | 1             | ..            | ..              |
| Dhoby .. ..                | 8                  | 4                 | 1             | 1             | 2               |
| Estate manager .. ..       | ..                 | 1                 | ..            | 3             | ..              |
| Farmer .. ..               | 202                | 135               | 38            | 22            | 45              |
| Goldsmith .. ..            | 1                  | ..                | ..            | 1             | 1               |
| Hotelkeeper .. ..          | ..                 | 3                 | ..            | 1             | ..              |
| Key vendor .. ..           | ..                 | ..                | ..            | ..            | 1               |
| Labourer .. ..             | 73                 | 93                | 8             | 101           | 51              |
| Landlord .. ..             | ..                 | 2                 | ..            | 12            | 4               |
| Mistry .. ..               | ..                 | 1                 | ..            | ..            | ..              |
| Mason .. ..                | ..                 | ..                | ..            | 1             | 1               |
| Merchant (wholesale) .. .. | 10                 | 1                 | ..            | 1             | ..              |
| Native doctor .. ..        | 1                  | 1                 | ..            | ..            | ..              |
| Oil maker .. ..            | 1                  | 5                 | ..            | 6             | 2               |
| Oil vendor† .. ..          | ..                 | ..                | ..            | 1             | ..              |
| Potter .. ..               | ..                 | 3                 | ..            | ..            | 1               |
| Sculptor .. ..             | 1                  | ..                | ..            | ..            | ..              |
| Shepherd .. ..             | ..                 | ..                | ..            | 1             | ..              |
| Shopkeeper .. ..           | 1                  | 7                 | 1             | 2             | 2               |
| Teacher .. ..              | 3                  | 1                 | 1†            | 2             | 1               |
| Temple priest .. ..        | ..                 | 1                 | ..            | 7             | 2               |
| Toddy overseer .. ..       | ..                 | ..                | ..            | 1             | ..              |
| Toddy shopkeeper .. ..     | 1                  | 2                 | ..            | ..            | ..              |
| Toddy tapper .. ..         | 1                  | 10                | ..            | 13            | 5               |
| Village karnam§ .. ..      | ..                 | 2                 | ..            | 1             | ..              |
| „ munsiff§ .. ..           | 1                  | ..                | 1             | 1             | ..              |
| „ talayari§ .. ..          | ..                 | 1                 | ..            | 2             | ..              |
| „ watchman .. ..           | ..                 | ..                | ..            | 1             | ..              |
| No occupation given .. ..  | ..                 | 2                 | ..            | 13            | 4               |
| Totals .. ..               | 322                | 286               | 54            | 203           | 126             |

\* Table refers to head of family in each house. Figures obtained by house-to-house census.

† Refers to coco-nut, groundnut, and gingilly oil. A vendor sells it from house to house.

‡ Lives in village only during school year.

§ Munsiff is headman; karnams are assistants to munsiff; talayari is a village peon.

TABLE V  
Land ownership and income statistics in villages of economic survey, 1939-40

| Classification  | PATTUKKOTTAI TALUK |                   |               | TANJORE DELTA |                 |
|---|--------------------|-------------------|---------------|---------------|-----------------|
|   | Kasangadu          | Tuvaran-gurichchi | Senjayakollai | Ichchangudi   | Someswara-puram |
| Land owned by population (acres)                      | 1,147              | 897               | 508.8         | 181           | 364.1           |
| Average land holding per person (acres).              | 0.68               | 0.65              | 0.91          | 0.19          | 0.53            |
| Total ..  | 48,820             | 48,657            | 18,332/8      | 39,569        | 30,295          |
| Yearly income Per house ..                            | 151/10             | 170/2             | 345/8         | 194/15        | 242/6           |
| (rupees and Per capita ..                             | 29                 | 35/3              | 33/14         | 41/8          | 44/7            |
| annas). Per adult over 21.                            | 56/13              | 69/10             | 76/11         | 75/8          | 74/4            |
| Largest individual income (Rs.)                       | 1,330              | 3,750             | 2,000         | 3,000         | 9,550           |
| Number of families with yearly income Rs. 50 or more. | 306                | 285               | 50            | 193           | 117             |

TABLE VI  
Debt and interest statistics in villages of economic survey, 1939-40

| Classification                    | PATTUKKOTTAI TALUK |                   |               | TANJORE DELTA |                 |
|-----------------------------------|--------------------|-------------------|---------------|---------------|-----------------|
|                                   | Kasangadu          | Tuvaran-gurichchi | Senjayakollai | Ichchangudi   | Someswara-puram |
| Debts (rupees and annas).         | Total ..           | 90,421            | 25,001        | 24,870        | 25,830          |
|                                   | Per house ..       | 280/13            | 87/4          | 469/4         | 127/4           |
|                                   | Per capita ..      | 53/11             | 18/2          | 45/15         | 27/1            |
|                                   | Per adult over 21. | 105/5             | 35/13         | 104/1         | 49/5            |
| Interest paid (rupees and annas). | Total ..           | 5,616/15          | 1,485/1       | 2,314/1       | 1,549/3         |
|                                   |                    |                   |               |               | 1,461/0         |

TABLE VII  
Taxation statistics in villages of economic survey, 1939-40\*

| Description                              | PATTUKKOTTAI TALUK |                   |               | TANJORE DELTA |                 |
|--|--------------------|-------------------|---------------|---------------|-----------------|
|  | Kasangadu          | Tuvaran-gurichchi | Senjayakollai | Ichchangudi   | Someswara-puram |
| Total Government taxes ..                | 3,515/4            | 3,020/4           | 3,190/8       | 3,104         | 3,438/12        |
| Non-Government taxes ..                  | 2,021/8            | 2,853/4           | 2,853/4       | 1,029/8       | 1,448/8         |
| All taxes ..                             | 5,536/12           | 5,873/8           | 3,190/8       | 4,133/8       | 4,887/4         |
| Yearly taxes per house (rupees—rounded). | 17/0               | 21/0              | 60/0          | 20/0          | 39/0            |
| Rent paid ..                             |                    | 18/0              | 1/8           | 223/12        | 69/0            |
| Total payments for taxes and debts.      | 11,153/11          | 7,376/9           | 5,506/0       | 5,906/7       | 6,417/4         |
| Yearly payments per house ..             | 35/0               | 26/0              | 104/0         | 29/0          | 51/0            |
| Government tax collections.†             | 1,876/1            | 4,517/8‡          | 1,257/7¶      | 1,838/9/10    | 1,296/15/7      |
| Per house‡ ..                            | 6/0                | 16/0              | 9/0           | 9/0/0         | 10/0/0          |

\* All figures in rupees. See footnote in table II. Figures (other than Government collections) obtained by two malaria officers in a house-to-house canvass. Figures per house rounded off in even rupees. See text for explanations.

† Includes land and water taxes. Figures obtained by courtesy of taluk officials.

‡ Includes non-Government taxes and payments of interest on debts.

§ Excluding hamlet of Kallikkadu, not included in economic survey.

¶ Figure estimated for Senjayakollai on basis of total for Virakkurichchi of which Senjayakollai is a hamlet.

Rs. 44-7-0 in Someswarapuram. The average *per capita* income for all five communities was about Rs. 35-4-0 per annum. Income in these villages was mainly from agriculture, derived from the sale of produce, and to a considerable extent from wages for agricultural labour. Income from business sources was small. The largest individual income was Rs. 9,550-0-0 in Someswarapuram (high and unusual).

5. *Debts and interest.*—Table VI gives particulars of debts and interest. Debts per house varied from Rs. 469-4-0 in Senjayakollai to Rs. 87-4-0 in Tuvarangurichchi. In the former village and in Kasangadu, total debts per house were greater than total annual income. For all the villages together, average debt *per capita* amounted to Rs. 36-3-0, which slightly exceeds the figure for average *per capita* annual income.

The actual total annual payments as interest on debts are also shown in table VI. These figures do not reveal exorbitant rates as regards interest payments. The percentages which

these payments represented in relation to the total debts were as follows:—

|                     | Per cent |
|---------------------|----------|
| Kasangadu ..        | 6.2      |
| Tuvarangurichchi .. | 6.0      |
| Senjayakollai ..    | 9.3      |
| Ichchangudi ..      | 6.0      |
| Someswarapuram ..   | 6.0      |

But it must be noted that interest payments on debts are usually considerably less than the amounts claimed. Interest in full is seldom paid when it falls due.

6. *Taxes.*—Taxes are considered in table VII. The villages under study were of two kinds in respect of taxation and ownership. In Pattukkottai taluk, Kasangadu and Tuvarangurichchi were *inam* villages and Senjayakollai a Government village. Both villages in the delta were *inam* villages. An *inam* village is one in which ownership of the village is vested in a private individual or institution, and the *inamdār* (the



owner) pays only a nominal tax, called quit rent, to the Government. He receives the land tax (commonly called rent) from the ryots. A Government village is one in which the ryots have a direct relation with the Government and pay their land taxes directly to the Government through village officers. Therefore actual receipts by Government from these two types of villages will vary considerably. In the inam village, the major part of payments on land by ryots is retained by the inamdar, while in the Government village the entire amount goes to Government.

In the present study the aim has been to gather information about actual payments of taxes by the ryots and for this purpose figures in Government records do not give a full picture. A ryot actually pays not only for the land he owns in the particular village in which he lives but also for lands he may own in other villages. Further, there are generally a large number of lands in any village owned and paid for by persons living in outside places. Government and inamdars collect revenue on the basis of the acreage of land actually existing in the particular village. It is important to determine the taxation paid by ryots per head of population rather than the taxation per acre. This gives a better picture of the financial condition of the ryots. Note of this fact has been taken in estimation of income per head of the population, because many persons receive incomes from property or business not actually earned within the limits of their own village. This outside income has been included.

Every ryot pays two kinds of taxes, (1) a land tax paid either directly to Government or to the inamdar or zemindar, based on the area of his holding and the type of cultivation; (2) a special water tax, levied and collected by Government for irrigation water from Government sources (Cauvery-Mettur canals in Pattukkottai taluk, the river and its channels in the delta). The rate per acre will depend on whether a single or a double crop is raised. These taxes have been combined and classified for the sake of simplicity into two main heads, viz, (1) Government taxes, i.e., all payments made directly to Government, whether for land or water, and (2) non-Government taxes paid to inamdars, zemindars, or local bodies.

From table VII it can be seen that the total taxation per house varied from Rs. 60-0-0 in Senjayakollai to Rs. 17-0-0 in Kasangadu. The percentages of yearly income per house paid in taxes were as follows :—

|                              | Per cent |
|------------------------------|----------|
| Pattukkottai { Kasangadu ..  | 11.2     |
| taluk. { Tuvarangurichchi .. | 12.4     |
| { Senjayakollai ..           | 17.3     |
| Tanjore { Ichchangudi ..     | 10.3     |
| delta. { Someswarapuram ..   | 16.1     |

Combining the total of all taxes and interest paid, the proportions of average income per

house which were paid for these two items were as follows :—

|                              | Per cent |
|------------------------------|----------|
| Pattukkottai { Kasangadu ..  | 23.0     |
| taluk. { Tuvarangurichchi .. | 15.0     |
| { Senjayakollai ..           | 30.0     |
| Tanjore { Ichchangudi ..     | 15.0     |
| delta. { Someswarapuram ..   | 21.0     |

7. *Vital statistics and malaria rates.*—Birth, death, and infant mortality rates are given in table VIII. These were compiled from official sources and are in line with the survey observations. Birth rates varied from 41.3 in Tuvarangurichchi to 34.4 in Kasangadu. Death rates were as high as 29.0 in Someswarapuram and as low as 16.6 in Virakkurichchi, of which Senjayakollai is a hamlet. The infant mortality was highest in Tuvarangurichchi, where it was 193 per 1,000 live births. It was lowest in Kasangadu at 138 per 1,000 live births.

It will be seen that the two non-malarious villages surveyed had lower birth rates and higher death and infant mortality rates than the three malarious villages. Malaria in Pattukkottai taluk is a new affliction dating only to 1933-34 and prior to this the taluk is said to have been relatively more healthy than the contiguous delta.

In table IX malaria parasite and spleen rates are given. These were obtained in the course of routine epidemiological studies. Usually two surveys a year have been made, one in April or May, during the off-season, and one in October or November, which is the peak of the malaria season. Such surveys in 1939 indicated the total absence of malaria in the Tanjore delta. But Pattukkottai taluk was malarious.

During the 1938, 1939, and 1940 malaria seasons experimental control was obtained in Kasangadu by spray-killing adults (Russell and Knipe, 1939, 1940, 1941). The results are reflected by falling parasite and spleen rates. The village of Tuvarangurichchi, which is some two miles from Kasangadu and similar in all respects, was used as an experimental control, no malaria prophylaxis of any sort being done. It will be seen (table IX) that no corresponding decline occurred there in parasite and spleen rates. In Senjayakollai, in 1938 and 1939, minor engineering control, such as filling borrow-pits, ditching, and using paris-green, was accomplished. Rice fields and field channels were not controlled and the malaria rates subsided less notably than in Kasangadu.

8. *Losses due to fevers.*—Table X gives particulars regarding payments for fevers, and days and wages lost through fevers. Answers given by the people were carefully scrutinized by the medical officers and the figures presented herewith refer only to fevers these officers believe to have been due to malaria. It will be noted that actual payments for fevers were Rs. 2-8-0 per capita in Tuvarangurichchi and

TABLE VIII

Birth, death, and infant mortality statistics in villages of economic survey, 1937-39\*  
(Birth, death, and infant mortality rates per mille)

| Description   |   | PATTUKKOTTAI TALUK |                       |                      | TANJORE DELTA |                     |
|---------------|---|--------------------|-----------------------|----------------------|---------------|---------------------|
|               | Year  | Kasangadu          | Tuvaran-<br>gurichchi | Virak-<br>kurichchi† | Ichchangudi   | Somesvara-<br>puram |
| Births        | 1937  | 66                 | ‡                     | 19                   | 31            | 26                  |
|               | 1938  | 56                 | 56                    | 20                   | 39            | 23                  |
|               | 1939  | 51                 | 57                    | 24                   | 31            | 22                  |
|               | Average num-<br>ber of live births<br>per 1,000 in-<br>dividuals.                 | 34.4               | 41.3                  | 38.8                 | 35.6          | 34.8                |
|               |   |                    |                       |                      |               |                     |
| Deaths        | 1937  | 62                 | ‡                     | 7                    | 18            | 28                  |
|               | 1938  | 39                 | 33                    | 10                   | 27            | 18                  |
|               | 1939  | 28                 | 37                    | 11                   | 26            | 14                  |
|               | Average num-<br>ber of deaths per<br>1,000 individ-<br>uals.                      | 25.5               | 25.3                  | 16.6                 | 25.2          | 29.0                |
|               |   |                    |                       |                      |               |                     |
| Infant deaths | 1937  | 12                 | ‡                     | 5                    | 3             | 7                   |
|               | 1938  | 7                  | 13                    | 3                    | 6             | 4                   |
|               | 1939  | 6                  | 8                     | 2                    | 10            | 2                   |
|               | Average infant<br>death rate per<br>1,000 live births<br>(infant mor-<br>tality). | 138                | 193                   | 143                  | 176           | 167                 |
|               |   |                    |                       |                      |               |                     |

\* All figures by courtesy of taluk officials. House-to-house canvass furnished evidence as to general reliability of the figures.

† Senjayakollai is one hamlet of Virakkurichchi for which figures have been given. The averages may be taken as typical for Senjayakollai.

‡ Figures not available.

Re. 1-6-0 in Kasangadu. There was no malaria in the delta villages and therefore no figures are given for payments or days lost due to fevers. In Senjayakollai adequate information in this regard was not obtained. *Per capita* wages reported lost by fevers were Re. 1-6-0 in Tuvarangurichchi and Re. 0-12-0 in Kasangadu. The *per capita* days lost due to fevers were 4.9 in Kasangadu and 10.5 in Tuvarangurichchi. The days lost per adult member of the population during the previous year were 9.7 and 20.7 respectively.

Table XI was prepared from a survey of some labourers working on the malaria control project in Senjayakollai. These labourers live in one hamlet of Virakkurichchi, of which Senjayakollai is another. It will be seen that illness costs on the average per week Rs. 3-7-6 for a man, Rs. 4-5-0 for a woman, and Re. 1-10-8 for a child in this area. The largest items of expense were for travel, offerings, and temple sacrifices of fowls, sheep or goats. Temple and church candles cost Re. 0-0-9 each and generally one to three will be purchased during such an illness as an attack of malaria. The table does not include loss of wages, which for men would average about Re. 0-6-0, for women Re. 0-4-0, and for children over 12, Re. 0-2-0 per day. A week's illness would probably mean a loss to an adult male labourer of at least Rs. 2-0-0 wages *plus* Rs. 3-7-8 extra expense.

### Discussion

A. *General.*—Before proceeding to discuss the economic burden of malaria in these villages, some basic findings of this survey may be compared with those of other surveys. Birth rates in the villages surveyed were about the same as those for Madras Presidency and a little higher than British India. Death rates were a little higher. Infant mortality rates were about the same as for British India and a little lower than for Madras Presidency. The following rates show these and other comparisons:—

|  | Birth<br>rate | Death<br>rate | Infant<br>mortality<br>rate |
|--|---------------|---------------|-----------------------------|
| Three Pattukkottai taluk<br>villages surveyed. | 38.2          | 22.5          | 158                         |
| Two Tanjore delta vil-<br>lages surveyed.      | 35.2          | 27.1          | 172                         |
| Average all five villages<br>surveyed.         | 37.0          | 24.3          | 163                         |
| British India (1937)                           | 34.5          | 22.4          | 162                         |
| England and Wales (1937)                       | 14.9          | 12.4          | 58                          |
| Federated Malay States<br>(1937).              | 37.8          | 19.9          | 147                         |
| Madras Presidency (1937)                       | 36.0          | 22.3          | 170                         |

Note.—Figures other than for surveyed villages taken from the 1937 report of Public Health Commissioner (Russell, 1939). For surveyed villages, figures are averages from table VII.

TABLE IX  
Malaria parasite and spleen rates in villages of economic survey, 1937-39

| Village                   | Year | Season*  | Parasite rate | Spleen rate |
|---------------------------|------|----------|---------------|-------------|
| Kasangadu† .. .. .        | 1937 | Off      | 38            | 42          |
|                           | 1937 | Malaria  | 57            | 68          |
|                           | 1938 | Off      | 40            | 41          |
|                           | 1938 | Malaria  | 12            | 24          |
|                           | 1939 | Off      | 4             | 9           |
|                           | 1939 | Malaria  | 6             | 15          |
| Tuvarangurichchi‡ .. .. . | 1937 | Off      | 35            | 43          |
|                           | 1937 | Malaria  | 45            | 55          |
|                           | 1938 | Off      | 37            | 41          |
|                           | 1938 | Malaria  | 52            | 61          |
|                           | 1939 | Off      | 33            | 48          |
|                           | 1939 | Malaria  | 48            | 57          |
| Senjayakollai§ .. .. .    | 1937 | Malaria  | 42            | 48          |
|                           | 1938 | Off      | 28            | 33          |
|                           | 1938 | Malaria  | 31            | 44          |
|                           | 1939 | Off      | 33            | 12          |
|                           | 1939 | Malaria  | 32            | 26          |
| Ichchangudi¶ .. .. .      | 1939 | April    | 0             | 0           |
|                           | 1939 | November | 0             | 0           |
| Someswarapuram¶ .. .. .   | 1939 | April    | 0             | 2           |
|                           | 1939 | November | 0             | 2           |

\* In Pattukkottai taluk the malaria season extends from July to the following January.

† Malaria control by spray-killing adult mosquitoes was carried out in Kasangadu in 1938 and 1939, hence the fall in rates.

‡ No control measures have been carried out in Tuvarangurichchi, which furnishes a suitable contrast village to Kasangadu.

§ Malaria control by minor engineering measures was carried out in Senjayakollai in 1938 and 1939 and resulted in some decrease in rates.

¶ Ichchangudi and Someswarapuram are in a portion of the Tanjore delta where there is no evidence of malaria.

TABLE X  
Expense of fevers in villages of economic survey, 1939-40\*

| Classification                   | PATTUKKOTTAI TALUK |                       |               | TANJORE DELTA |                     |
|----------------------------------|--------------------|-----------------------|---------------|---------------|---------------------|
|                                  | Kasangadu          | Tuvaran-<br>gurichchi | Senjayakollai | Ichchangudi   | Someswara-<br>puram |
| Payments for fevers yearly.      | Total ..           | 2,298                 | 2,819         | †             | Nil                 |
|                                  | Per house          | 7/2                   | 9/13          | †             | "                   |
|                                  | Per capita         | 1/6                   | 2/8           | †             | "                   |
|                                  | Per adult          | 2/11                  | 4             | †             | "                   |
|                                  | over 21.           |                       |               |               |                     |
| Days lost through fevers yearly. | Total ..           | 8,307                 | 14,449        | †             | Nil                 |
|                                  | Per house          | 25.8                  | 50.5          | †             | "                   |
|                                  | Per capita         | 4.9                   | 10.5          | †             | "                   |
|                                  | Per adult          | 9.7                   | 20.7          | †             | "                   |
|                                  | over 21.           |                       |               |               |                     |
| Wages lost by fevers yearly.     | Total ..           | 1,276                 | 1,964         | †             | Nil                 |
|                                  | Per house          | 4                     | 6/14          | †             | "                   |
|                                  | Per capita         | -/12                  | 1/6           | †             | "                   |
|                                  | Per adult          | 1/8                   | 2/13          | †             | "                   |
|                                  | over 21.           |                       |               |               |                     |

\* Enquiries regarding fevers were directed to obtain evidence of actual attacks of malaria, as manifested by typical symptoms. Figures in rupees. See footnote table II. Figures obtained in house-to-house canvass by two malaria officers.

† Questioning insufficient, information inadequate.

TABLE XI

Average cost of illness for individuals of labouring class in Virakkurichchi, April to June 1940\*

| Description  | Cost of medicine | Cost of medical attendance | Cost of special food | Other incidentals like travel and offerings to God | Total expense incurred | Average expenditure per individual | Average duration of illness per individual in weeks | Average expense per head per week |
|--|------------------|----------------------------|----------------------|--|------------------------|------------------------------------|---|-----------------------------------|
|  | Rs. A. P.        | Rs. A. P.                  | Rs. A. P.            | Rs. A. P.  | Rs. A. P.              | Rs. A. P.                          |   | Rs. A. P.                         |
| <i>Man</i><br>Expenses incurred by 32 men for 48 weeks of illness.         | 23 8 0           | 35 9 6                     | 44 2 0               | 63 6 0   | 166 9 6                | 5 3 3                              | 1.5   | 3 7 6                             |
| <i>Woman</i><br>Expenses incurred by 32 women for 40 5/7 weeks of illness. | 36 1 6           | 40 11 0                    | 44 7 0               | 54 2 0   | 175 5 6                | 5 9 8                              | 1.3   | 4 5 0                             |
| <i>Child</i><br>Expenses incurred by 30 children for 25 weeks of illness.  | 12 2 0           | 10 2 0                     | 12 2 6               | 10 7 0   | 44 13 6                | 1 7 11                             | 0.8   | 1 10 8                            |

\* Amounts are given in Indian rupees. See footnote in table II.

The density of population per house in the five communities surveyed agrees with figures calculated from Government census figures of 1931, which were 5.3 per house in Pattukkottai taluk and 5.1 per house in Papanasam taluk.

As regards annual income, Sinton (1935) quoted the following estimates of average annual income per head of population in India :—

|                     |              |        |                        |
|---------------------|--------------|--------|------------------------|
| Lord Curzon         | .. 1901      | Rs. 30 |                        |
| Sharma ..           | .. 1911      | " 86   |                        |
| Horne ..            | .. 1918      | " 42   |                        |
| Slater ..           | .. 1918 over | " 70   | for Madras Presidency. |
| Shah ..             | .. 1921-22   | " 46   |                        |
| Simon Commission .. | .. 1928      | " 110  |                        |
| Visweswaraya ..     | .. 1933      | " 60   |                        |
| Joshi ..            | .. 1933      | " 53   |                        |
| Hindustan Times ..  | .. 1934      | " 45   |                        |

Incomes *per capita* in the surveyed villages varied from Rs. 29-0-0 to Rs. 44-7-0, averaging Rs. 35-4-0, which is somewhat less than the estimates above and much less than that given by Slater for Madras Presidency in 1918. The average agrees more closely with an estimate of Rs. 39-0-0 *per capita* for rural dwellers in India, made by Singh (1940).

Shirras (1937) gives the following figures for *per capita* annual income in British India by years :—

| Year | Per capita income |            |
|------|-------------------|------------|
|      | Rupees            | £ Sterling |
| 1871 | 20                | 2.0        |
| 1881 | 27                | 2.7        |
| 1901 | 30                | 2.0        |
| 1911 | 80                | 5.3        |
| 1921 | 119               | 8.8        |
| 1924 | 126               | 9.5        |
| 1925 | 114               | 8.5        |
| 1927 | 108               | 8.1        |
| 1931 | 63                | 4.7        |
| 1932 | 58                | 4.4        |

Shirras (1937) also gives some figures for *per capita* annual incomes in other countries for comparison with India, as follows :—

| Country        | Year | Per capita income, £ Sterling |
|----------------|------|-------------------------------|
| United Kingdom | 1931 | 76                            |
| Canada ..      | 1927 | 119                           |
| Bulgaria ..    | 1932 | 9                             |
| Russia ..      | 1925 | 10                            |
| U. S. A. ..    | 1932 | 89                            |
| Japan ..       | 1925 | 14                            |
| Italy ..       | 1927 | 24                            |

There was obviously a steep decline in incomes in India from 1924 to 1932. It is possible that there has been a further decline since then. It is also obvious that the *per capita* income in India is low as compared with other countries.

It is also interesting to compare tax figures from several countries with those in India. Shirras (1937) gives the following figures to show what percentage of national income is paid out for total taxes :—

| Country           | Year    | Percentage of income from taxation |
|-------------------|---------|------------------------------------|
| India ..          | 1932-33 | 10.1                               |
| United Kingdom .. | 1931-32 | 25.6                               |
| Canada ..         | 1927    | 9.5                                |
| U. S. A. ..       | 1932    | 18.5                               |
| Japan ..          | 1925    | 12.8                               |
| Italy ..          | 1927    | 22.3                               |

From the income and percentage of taxation figures of Shirras, already given, one can

construct a table of net income, i.e., income less taxation, as follows :—

| Country              | Year | Net income,<br>£ Sterling |
|----------------------|------|---------------------------|
| India .. ..          | 1932 | 3.96                      |
| United Kingdom .. .. | 1931 | 56.54                     |
| Canada .. ..         | 1927 | 107.7                     |
| U. S. A. .. ..       | 1932 | 72.54                     |
| Japan .. ..          | 1925 | 12.21                     |
| Italy .. ..          | 1927 | 18.65                     |

Although the actual percentage of taxation in India is less than that in such countries as the United Kingdom and the United States of America, yet the net *per capita* income remaining in India is very low. When it is realized that from this net residue a further deduction has to be made for interest on debts with which practically every rural dweller is burdened, it becomes apparent that not much is left to the ryots themselves to pay for such 'luxuries' as malaria control, however good a financial investment it could be proved to be.

Sinton (1935) stated that from figures given by various workers it did not seem to be an over-estimation to consider that the average earning capacity of an adult male in India was Rs. 10-0-0 per mensem and of a female Rs. 5-0-0, the term adult referring to those between the ages of 15 and 50. The average annual income per adult above 21 years in the area surveyed ranges between Rs. 56-13-0 in Kasangadu and Rs. 74-4-0 in Someswarapuram. On the basis of the present study and from general experience in this area it seems likely that monthly averages are of the magnitude of Rs. 6-0-0 or Rs. 7-0-0 per adult male and about Rs. 4-0-0 per adult female among the rural population. As regards wages and days lost, it may be noted that it is customary for a mother to remain at home when her child is seriously ill.

B. *Economic burden of malaria*.—The direct losses to an individual, as a result of attacks of malaria, are chiefly :—

- loss of wages, if a labourer, or loss of working days on the crops, if a farmer;
- payments for treatment and special food;
- payments for temple and church offerings.

The indirect losses are :—

- loss of efficiency and hence of earning power;
- reduction in expectation of life.

It is difficult to assess accurately the money losses due to malaria. The residents of the villages surveyed were questioned very carefully regarding amount paid for medicines and doctors, and for other expenses in connection with malarial fevers. The individual estimates make fairly large totals in Kasangadu and Tuvarangurichchi, as shown in table X. In Tuvarangurichchi, where no malaria control has been done, the *per capita* payment for fevers

amounted to Rs. 2-8-0 and the estimated wages lost *per capita* was Re. 1-6-0, making a direct total loss of Rs. 3-14-0 *per capita* per annum.

King quoted by Sinton (1935) estimated in 1911 in Madras that during an illness lasting 14 days, the cost of extra necessities and food, medical attendance, medicine, etc., in the case of an adult of the lowest labouring class, was Rs. 2-0-0 and of a child Re. 1-8-0. In view of the increased cost of living since 1911, these figures are comparable to those given in table XI.

No account is taken in the above calculation of the indirect losses due to anæmia. Since there is very little use made of antimalaria drugs, relapses and chronic debility are common and no doubt reduce the yearly income. It is interesting in this connection that the average *per capita* income for the three malarious villages was Rs. 32-0-0 and for the two non-malarious villages Rs. 45-0-0. Of course, it is illogical to say that this difference was entirely due to malaria because other possible causes could be suggested, as for example, the greater fertility of the delta lands and therefore greater yield of grain. In fact, double crops are the rule in the delta but the exception in the Pattukkottai villages surveyed. The latter villages are still in process of conversion from dry to wet lands and are not completely developed.

But the two groups of villages are almost the same racially and socially, and no doubt malaria must be one of the factors accounting for the difference in *per capita* incomes. The rate of development following the new irrigation scheme has no doubt already been retarded by malaria in Pattukkottai taluk.

Sinton (1935) analysing the extensive data available to him stated that in India it would appear to be a conservative estimate to assume that the number of adult days lost per head of malaria-infected population each year at least equals half a month. The figures of the present survey do not differ greatly from Sinton's estimate. The combined average for Kasangadu and Tuvarangurichchi works out at 14.7 days per adult over 21 years of age.

As regards funeral expenses, malaria by lowering the expectation of life and by taking heaviest toll from the young, adds an increased burden for it removes many individuals before they have had time to contribute towards their own funeral expenses. Such expenses probably average from Rs. 12-0-0 per adult to Rs. 4-0-0 per child in the area surveyed.

Sinton (1935) stated that data available suggested that in an Indian population the loss of efficiency among malaria-infected persons may be at least as high as 25 per cent. An individual constantly suffering from attacks of malaria cannot hope to keep fixed employment. A ryot who is frequently ill during the crop season, and in Pattukkottai this coincides with the malaria season, is apt to produce less and consequently to suffer financial loss.

C. *Economics of malaria control.*—The question arises, whether or not the communities under study can afford to control malaria at their own expense. From the strictly economic point of view there seems no doubt that these villages could spend at least Re. 1-0-0 *per capita* per year for malaria control and, if the control measures succeeded, they would be financially better off, not to mention indirect gains which would doubtless be considerable. In Tuvurangurichchi, for example, the total loss due to payments for fevers and to wages not received amounted to Rs. 4,783-0-0, an average of Rs. 3-14-0 *per capita*. Malaria in this village could be controlled by spray killing at a cost of about Re. 0-4-0 *per capita* per year (Russell and Knipe, 1941). There is no doubt that this village by controlling malaria would be better off to the extent of about Rs. 3-10-0 *per capita* per year.

One frequently reads that rural communities in the tropics cannot themselves afford to control malaria. This may be true in South India as regards malaria control by traditional methods of screening, drug prophylaxis, ditching, paris-greening, and oiling. Costs for such measures in rural communities have seldom fallen below Rs. 2-0-0 annually *per capita* and have usually been higher. But newer methods are being developed. For example, in some experiments in the area of our economic survey in Kasangadu, where there are innumerable breeding places in wells, pits, rice fields, canals, and channels, malaria has been controlled by spray-killing adult mosquitoes at an annual *per capita* cost of Re. 0-7-2 (Russell and Knipe, 1941). Using Indian-grown pyrethrum in another village in the same area the cost was Re. 0-4-7 *per capita* per season.

In Ennore, another Madras rural area where breeding places are largely pools, it was suggested, on the basis of experimental evidence, that control could be obtained by use of *Gambusia* fishes at costs around Re. 0-5-10 *per capita* per year (Russell and Jacob, 1939). In this same area other experiments indicated that by a cheap method of spreading paris-green, control might be obtained at cost around Re. 0-1-5 *per capita* per year (Russell and Jacob, 1939a).

But it seems highly improbable that villages having already so relatively high a burden of debt and taxes, and having net annual incomes *per capita* that average only £2-4-0 (or about U. S. \$10 to 16), could ever be persuaded voluntarily to add to their tax another rupee for what to them would seem doubtful gains. The consensus of opinion among local officers is that unless malaria could be controlled for about two annas *per capita* per year, there would be little hope of raising the cost from the villagers affected. Even two annas could be obtained only with difficulty from the ryots themselves.

Undoubtedly, the provincial government that collects the land and water taxes and that makes a profit from the sale of irrigation water, has a

definite obligation as regards malaria control in the villages surveyed, for malaria in this area is due to *A. culicifacies* which breeds chiefly in irrigation water, standing or running, in canals, channels, borrow-pits, rice fields, and wells (Russell, 1938). The water for which the ryots are taxed, and which may bring agricultural benefit to them, has also brought malaria. But although the Government has a definite liability apart from and beyond its normal responsibility for the health of the people, it is doubtful if it would or could put up a rupee *per capita* per year for malaria control in every malarious village. This would require an annual budget for malaria control of over Rs. 2,50,000 in Pattukkottai taluk alone, which is several times the total annual medical and health budget in this area at present. So that, however much one might emphasize that actually malaria in Pattukkottai taluk costs the people more than its control would cost, the chances of getting Re. 1-0-0 *per capita* for malaria control, either by direct taxation or by an annual grant, are practically nil.

But now that costs of control have been lowered to about one-quarter of a rupee there should be a real possibility that by joint effort between the local and provincial governments, by co-ordination of agriculture, public works and health departments, and by active co-operation of the ryots, malaria could be controlled. One logical step that could be taken immediately would be for the provincial government to set aside each year for malaria control a percentage of the irrigation tax.

A much more active and effective liaison between health, public works and agricultural departments is urgently required not only to correct the present prevalence of man-made malaria but to prevent the creation of similar hazards in the future.

### Conclusions

In conclusion, it appears that even in a sparsely settled agricultural community in the tropics it costs less to control malaria (by newer methods) than it does to pay the direct financial losses due to this disease, not to mention the considerable indirect losses. But it also appears that there is little hope of obtaining from the very small residue of income that remains to the local inhabitants, after they have paid their taxes and interest on debts, an extra tax for the control of malaria. Yet it would seem that there is a possibility of achieving control of rural malaria in the area surveyed at costs which would be financially feasible, provided that the provincial government was willing to forego a fraction of the income received from water taxes and would apply this to the task of correcting a situation for which it is largely responsible and provided also that effective co-operation was maintained between agriculture, public works and health departments.



### Summary

A house-to-house survey in three malarious and two non-malarious villages in rural areas of Tanjore District, Mādras, revealed the following facts regarding the social and economic condition of the population :—

1. The actual populations of the villages at the time of the survey were as follows :—Kasangadu 1,684, Tuvarangurichchi 1,381, Senjayakollai 557, Ichchangudi 954, and Someswarapuram 690. The first three were malarious, the latter two non-malarious.

2. Sex and age ratios were normal, although females were slightly in excess of males in each of the villages.

3. Density of population per house varied from 4.7 to 10.5.

4. Birth rates varied from 34.4 to 41.3, death rates from 16.6 to 29.0, and infant mortality rates 138.0 to 193.0 per mille. These were typical of the locality.

5. The chief occupation was farming.

6. None of the houses were screened, bed-nets were rare, and no constructed latrines of any kind, sanitary or otherwise, were found.

7. The average land holding per person varied from 0.19 to 0.91 acre.

8. The number of cattle per person varied from 0.4 to 1.5. There was no evidence of zoonophylaxis in any of the villages.

9. Income from all sources varied between Rs. 29-0-0 and Rs. 44-7-0 *per capita* per annum and averaged Rs. 36-13-0. It ranged from Rs. 15-10-0 to Rs. 345-8-0 per house.

10. Total taxes paid varied between 10.3 and 17.3 per cent of total annual income per house.

11. Total debts varied between Rs. 18-2-0 and Rs. 53-11-0 *per capita* and the average rate of interest paid ranged between 6.0 and 9.3 per cent. The total payments per annum for taxes and debts varied from 15 to 30 per cent of the annual income per house.

12. In two malarious villages, days lost due to fevers averaged 4.9 and 10.5 *per capita* per annum. Payments for malarial fevers averaged Re. 1-6-0 and Rs. 2-8-0, and wages lost Re. 0-12-0 and Re. 1-6-0 *per capita* per annum in two villages.

13. The bearing of these facts on the financial aspect of malaria control has been discussed and it is concluded that the direct financial loss due to malaria is considerably more than the amount it would actually cost to control this disease. There would seem to be no possibility, however, of inducing ryots to pay a special malaria tax out of the very small residue of income remaining when they have paid taxes and interest on debts.

14. Since malaria in this area springs chiefly from irrigation water, it would seem reasonable to expect Government to set aside annually a percentage of the irrigation tax for malaria control.

15. There is urgent need as regards malaria control for more effective co-operation between agriculture, public works, and health departments.

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## Current Topics

### The First-Aid Treatment of Burns

By A. B. WALLACE, M.Sc., M.B., F.R.C.S.E.D.

(From the *Practitioner*, Vol. CXLVII, August 1941, p. 513)

THIS subject is of great importance. As a result of the present lack of uniformity in advice a patient may suffer from well-intentioned but misdirected procedures. Some general principles of first-aid organization may be useful:

(a) To notify the first-aid post, hospital, medical officer, or police by the quickest method—telephone, messenger, warden—and to arrange for conveying the patient.

(b) To give all possible help to the medical officer and police, and to follow instructions implicitly.

(c) To decide quickly whether the initial treatment should be for the injury or for shock.

#### RESCUE PROCEDURES

As a result of the frequent use of incendiary and high-explosive bombs many emergencies will confront the populace, who must be in a state of preparedness. There is, as a rule, only one opportunity: that of the moment.

(1) *Patient trapped in a burning room.*—The patient may have collapsed from inhalation of smoke, or be poisoned by carbon monoxide. Quick removal of the patient will be necessary to save his life. The first-aid worker applies his gas mask or ties a handkerchief soaked in water (or vinegar one part and water three parts) around his nose and head, so that the broad part covers his nose and mouth. After taking several deep breaths he crawls along the floor of the room, seizes the patient and pulls or carries him to safety, and if necessary applies artificial respiration. In a serious case the hospital, first-aid post, or police is notified immediately, and the need for a cylinder of oxygen with 5 per cent carbon dioxide indicated.

(2) *Patient with clothes on fire.*—Since flames ascend, the patient is laid down—forcibly if necessary with the flames uppermost—and these are smothered with a coat, rug, or blanket rather than extinguished by water. Treatment as for a burn is then carried out.

(3) *Patient with electric shock and/or burn.*—A summary of the 'Electrical Review's' suggestions for dealing with electric shock is given:—

In many cases when persons receive electric shocks, death is only apparent. With the prompt application of first aid, practically every victim can be revived. The method of resuscitation resorted to is artificial respiration. Steady persistent effort is one of the essential conditions of successful attempts to restore animation. In cases of severe shock, respiration is seldom established under one hour, and three hours may be necessary to restore normal breathing. Artificial respiration is not stopped until the patient breathes normally or until a medical practitioner has pronounced life extinct. The electric circuit is broken at once if there is an interrupter close at hand; if not the body must be removed as soon as possible from contact with the live conductor. The body must not be touched with the hands unless protected by india-rubber gloves. If these are not available, the patient can be pulled off the live conductor by his coat tail, if his clothes are not wet, or pushed off the wires with a broom handle. The rescuer, for additional precaution, can stand on a dry board or on a thick newspaper or bundle of sacking, or he can charge the body with the shoulder.

Once the body is pulled from the live conductor the case is treated as one of drowning. The patient is placed face downwards on a dry mattress. Schafer's method of artificial breathing is begun and continued at a rate of fifteen times a minute until natural breathing is established. If help is available, loosen any tight clothing about the neck, chest, or waist, but do not stop artificial respiration in order to do so.

The efforts to restore breathing must be carried out with perseverance, as in some cases it has been restored after a long period of apparent death. During the procedures the patient must be kept warm. Circulation may be aided by rubbing the body, or striking it with a wet towel. An assistant may strike the patient's shoe heels with a stick some twenty times at intervals of five minutes. When it is possible to procure a cylinder of oxygen, inhalation may be attempted if administered under medical supervision. Stimulants should not be administered unless ordered by a medical practitioner. If one is not present, a teaspoonful of sal volatile in a small glass of water may be given if the patient can swallow. The patient must not be moved until his breathing has returned to normal without assistance.

(4) *Patient with scalds from burst steam boilers or pipes.*—These may result from the bombing of factories and hospitals in which steam is necessary to carry out the daily work. It must be arranged that in the event

of an emergency the steam can be turned off at a moment's notice.

The following points must be attended to in the general examination:—

(i) The nature of the case is determined before applying treatment.

(ii) If there is doubt whether the patient is alive or dead, the patient is treated as if he were alive.

(iii) When possible the history and symptoms of the case are ascertained, but no undue delay is permissible.

(iv) The patient is examined quickly and gently. *Clothing must not be removed to expose any burned surface.*

#### GENERAL POINTS IN TREATMENT

(a) Treatment is instituted immediately, and if necessary the first-aid post or hospital is notified.

(b) Shock must be prevented if possible.

(c) The first-aid student must carry out his duties in such a way that the patient is relieved of danger and pain, but he must bear in mind the limitations of his knowledge, and that he must not take upon himself the responsibilities of a medical practitioner. While first aid is being rendered the worker must consider also:—

(1) *How the patient is to be carried or lifted.*—He may be carried pick-a-back or by the fireman's lift or, if a second person be present, by the four-handed seat.

(2) *If a stretcher is necessary.*—If so, how can this be improvised or secured?

(3) *The method and provision of transport.*—By horse-drawn vehicle, car, or motor ambulance.

(4) *Where the patient is to be taken.*—If facilities and conditions in the first-aid post do not approximate to that of a hospital out-patient department, all cases of burns no matter the extent are referred directly to the nearest hospital. In all circumstances extensive burns are taken to hospital without delay. If the burn is of the size of the front of the hand or less, the patient can be taken to a first-aid post, unless the burn involves the hand itself or the face. All cases of burns of these regions, unless very trivial, are taken to hospital.

The complications of burns are shock, which accounts for 80 per cent of deaths, sepsis, local oedema and residual deformities. The two of special significance to the first-aid worker are shock and sepsis, and his efforts are directed to the control of both.

Pain, loss of heat and loss of fluid predispose to shock, and these should be prevented or at least minimized. Factors predisposing to infection are the presence of organisms in the skin; contamination of the injured surface from dirt, clothes, dressers and dressings; the presence of foreign bodies; the application of a coagulating substance before proper cleansing; and the application of substances which make later cleansing difficult, e.g., baking powder, flour, oils, petroleum jelly, antiseptics, such as picric acid and gentian violet.

#### PRINCIPLES OF FIRST-AID TREATMENT IN BURNS

*General.*—The patient is wrapped in blankets which are placed both below and over him. Protected hot-water bottles can be used as a source of additional warmth; they are placed outside the covering blanket. Hot sweetened tea is given to help to replace the lost fluid. If a medical officer accompanies the first-aid party he administers, if necessary, an injection of morphine,  $\frac{1}{2}$  grain to an adult. The time of injection and dose are noted, and sent to the hospital with the patient. In carbon monoxide poisoning, oxygen combined with 5 per cent carbon dioxide must be administered by the medical attendant.

*Local.*—Any exposed burn is covered with a clean sheet, clean cloth, or sterile towel. In certain circumstances a first-aid application is indicated, e.g., an airman who receives a burn on an operational flight, or a sailor burned at sea. In civil life the necessity seldom occurs. The essentials of a suitable first-aid dressing are to allay pain, to control oedema, to control infection, and to be miscible with water, so that when the patient arrives at hospital the substance can be removed readily and the dressing of choice applied.

Recently a glycerine-sulphonamide paste containing 5 per cent albucid has been described (Robson and Wallace), albucid is a water-soluble sulphonamide. Investigations are continuing, and the form at present favoured is a cream consisting of 30 per cent albucid soluble in glycerine (75 parts) and water (25 parts) mixed with sufficient eucerine to form a smooth cream. If preferred, the 30 per cent solution can also be made into a paste with kaolin. The paste can be carried in tins or tubes and applied directly to the affected part. It would appear to be useful for applying to burns received in action several hours or days before medical care is possible.

#### FIRST-AID TREATMENT OF BURNS OF SPECIAL PARTS

(1) *Eyes. Caustics.*—The excess must be removed and immediate flushing with water is the best treatment.

*Acids and alkalis.*—If neutralizing solutions are available, wash out: (a) Acids with bicarbonate of sodium, 1 teaspoonful to a pint; and (b) alkalis with milk or 2 per cent boracic acid lotion. If these solutions are not to hand, wash out with water *without delay*.

*Lime.*—(1) Wash out the eyes with tepid normal saline, or with water if the latter is not available. (2) Evert the upper eyelids and remove any lime which may be, and in fact so often is, adherent to the under surface of the lid. (3) Instil a few drops of liquid paraffin or olive oil.

(2) *Eye-lids.*—Smear with petroleum jelly or cold cream.

(3) *Nostrils.*—Smear with petroleum jelly or cold cream.

(4) *Ears.*—Plug with cotton-wool coated with sterile petroleum jelly; smear with petroleum jelly or cold cream.

(5) *Lips and mouth.*—Smear with petroleum jelly or cold cream.

(6) *Throat.*—This may be burned when the patient has been exposed to boiling water or steam. Apply to the neck a towel wrung out of hot water; give sips of cold water; get oxygen with 5 per cent carbon dioxide for inhalation.

#### CHEMICAL BURNS

*Corrosives.*—The general principle is to dilute with large quantities of warm normal saline or water and to remove any contaminated garments. Chemicals are quickly fixed in the tissues, and attempts at neutralization are unnecessary. However, if the burn is seen early, the following measures may be of benefit:

*Acid burn.*—Bathe in alkaline solution (a dessert-spoonful of washing or baking soda to one pint of water; ammonia or fluid magnesia can also be used).

*Alkaline burn.*—Bathe in weak acid solution (equal parts of vinegar and water).

After neutralization in both types, the lesion is treated as an ordinary burn.

#### BLISTER GAS BURNS

In the event of exposure to gas or vapour, gas masks are applied at once: if the irritation is serious and does not stop after a time, patients are taken to the nearest A.R.P. warden or member of a first-aid party. In patients suffering from liquid blister gas the liquid is dabbed, *not wiped*, off the skin with a handkerchief, then 'No. 2 anti-gas ointment' is rubbed well into the place. The handkerchief *must* be destroyed. If the ointment is not at hand, it can be obtained at the nearest chemist's shop. The ointment should be applied *within* five minutes of exposure. If this is impossible, wash at once with warm water. Take off any splashed outer garment *at once*. (Adapted from 'What to do about Gas' issued by the Ministry of Home Security.)

#### OTHER BURNS

*Electric burns.*—Treat as an ordinary burn.

*Phosphorus burns.*—The affected part is immersed in water; then a thick pad soaked in water is applied, and the patient is sent to hospital at once. Oils or greasy dressings *must not be applied*.

## Chemotherapy versus Combined Chemotherapy and Serum in the Treatment of Pneumonia

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(Abstracted from the *Journal of the American Medical Association*, Vol. CXVI, 24th May, 1941, p. 2366)

THE universal acceptance of the value of sulphonamide therapy in pneumonia has left the rôle of serum as the major current problem in the treatment of this disease. Will the use of serum combined with drug reduce still further the fatality rate? Will it cause a more rapid subsidence of the acute infectious process? These problems have been studied at Bellevue Hospital by using the alternate case method. Since February 1939, all pneumonia patients entering the wards of the First, Second and Fourth medical divisions have been alternated within the pneumococcus types between sulphonamide therapy alone and combined drug and serum therapy. In the present study we are reporting the results up to 1st January, 1941, in a series comprising 607 patients thus alternated.

#### METHOD

As soon as the clinical diagnosis of pneumonia was made, samples of blood and sputum were collected for bacteriologic study. The patient was then immediately placed on sulphonamide therapy without waiting for the results of typing. When the pneumococcus type was obtained, alternate patients in each type were placed in either the drug alone or drug plus serum group. If the patient fell in the drug plus serum group he was given, in addition to the drug, concentrated anti-pneumococcus rabbit serum. This was administered as soon as the specific type was obtained except when striking clinical improvement already had occurred and serum no longer would be of value. These patients, however, were left in the 'drug-plus-serum' group because to remove them would create a statistical error in favour of the drug-alone series. The first therapeutic dosage of serum was usually 100,000 units in uncomplicated cases and 200,000 units or more for known bacteremic or seriously ill patients. This dosage was repeated when necessary. Six patients who would have been due for serum survived less than twenty-four hours and died before typing was completed. These patients, therefore, received no serum but were necessarily counted in the serum group, it being one of the inherent disadvantages of serum therapy that there usually is some delay before serum can be started even under ideal circumstances. With the exception of these six twenty-four hour deaths, all other patients in the serum group who died received serum.

Several different sulphonamide drugs were used during the course of this study: sulphapyridine, dextrose-sulphapyridine, sodium sulphapyridine, sulphathiazole, sulphamethylthiazole and sulphadiazine. When a new drug was introduced, one or more whole wards were shifted from one drug to the other, and all patients entering these wards were treated with the new drug without interfering with the alternation of cases between the drug alone and the combined therapy groups. There was an occasional failure of response, and occasionally a maintenance dose higher than 1 gm. every four hours was used. A few patients received sodium sulphapyridine intravenously either to obtain a more rapid absorption or to procure a higher blood concentration of the drug.

Other forms of treatment including oxygen therapy, procedures for maintaining an adequate fluid intake, sedation and various symptomatic measures were used as indicated in both groups of cases.

This study included cases of both lobar pneumonia and bronchopneumonia. No patients were excluded except those with atypical congestive bronchopneumonia terminating some otherwise fatal disease such as carcinoma or heart disease. All other cases of pneumonia were included: systemic disease, no matter how serious, did not disqualify patients. A complete bacteriologic study was carried out in all cases; throat swab cultures were made when sputum was not obtainable; typing was repeated in all of the higher types and whenever the results were not conclusive; typing from the peritoneal exudate and from the brain of the mouse was used to supplement and confirm the findings in every case; admission blood cultures were always procured and repeated when indicated; chest fluid or any other specimen from a localized process obtainable either ante mortem or post mortem was sent to the laboratory for study. In addition almost every patient had at least one roentgen examination, blood counts, urinalyses and blood chemistry determinations, particularly the sulphonamide drug concentration.

#### SUMMARY AND CONCLUSIONS

1. A series of 607 cases of pneumococcal pneumonia was alternated in treatment, by type, between chemotherapy and combined chemotherapy and serum therapy.
2. The fatality rate in the drug-alone group was 9.3 per cent and in the drug-and-serum group 9.8 per cent. The fatality rates were 11.1 per cent and 14.6 per cent respectively if twenty-four hour deaths were included.
3. In the bacteremic cases the fatality rate was 28.1 per cent with drug alone and 30.0 per cent with drug and serum. If twenty-four hour deaths were included, the fatality rates became 32.8 per cent and 45.3 per cent respectively.
4. In contrasting the results of treatment in the cases treated early with those in cases treated late in the disease, the additional use of serum did not lower the fatality rate in either group.
5. The average response as judged by rapidity of fall in temperature in type I and type II cases was not enhanced by the use of serum.
6. No essential differences were noted in the therapeutic response obtained with the various drugs used—sulphapyridine, sulphathiazole, dextrose-sulphapyridine, sodium sulphapyridine, sulphamethylthiazole and sulphadiazine.
7. Of the 78 patients who died, 48 either entered the hospital in a near terminal condition and died within twenty-four hours or had some other severe systemic disease in addition to pneumonia.
8. The present rôle of serum in pneumonia appears to be its use in the treatment of patients who cannot tolerate the sulphonamide drugs or who do not respond satisfactorily within twenty-four to forty-eight hours to sulphonamide therapy.

#### Treatment of Hypothermia

(From the *British Medical Journal*, Vol. II,  
16th August, 1941, p. 231)

ABOUT two years ago Prof. Temple Fay and Dr. Lawrence Smith of Philadelphia issued their first clinical report on the effects upon cancer growth of a general lowering of the body temperature by about 10°F. They termed this general depression of body temperature 'hibernation', while local cooling of a tumour was called 'refrigeration'. This earlier work has already been reviewed in our columns. A group of workers at the Lenox Hill Hospital, New York, reinvestigated the effects of this method of general cooling, but called it 'cryotherapy'. A third careful research has appeared under the authorship of Dr. J. H. Talbot of Boston, and he has introduced the term 'hypothermia', which on the whole seems more satisfactory and comprehensive than any of the other terms. He has reviewed the literature and points out that the local application of cold for treatment of cancer dates back as early as 1865. Recent studies have shown

that regressive changes in tumours are most obvious when local hypothermia can be carried out at a temperature between 40° and 50°F. Special fitting coils through which a refrigerant circulates are applied and necrosis of tumour tissue may follow. Dr. A. McCravery has reported favourable results with local hypothermia in five cases of carcinoma of the bladder in which the bladder cavity had been marsupialized and exteriorized. In all cases the patient's life was prolonged beyond that expected for a patient not treated with hypothermia. It is possible that radiation combined with cold might be more effective than either alone, as the effects of cold upon the tumour cells are not so unlike those of radiation with x-rays. Talbot emphasizes that hypothermia is not looked on as a cure for cancer by even the most sanguine of its advocates, yet it does have a place in the treatment of a selected group of patients suffering from this disease. The Lenox Hill Hospital authorities publish a list of cases which are unsuitable for treatment by general hypothermia; it needs more careful consideration than does the local therapy.

Contrary to what has been taught hitherto, the lowest internal temperature that man can bear probably lies somewhere between 70° and 75° and not between 90° and 95°F. Two patients of Talbot and his colleague Tillotson had rectal temperatures of 74° and 75°F. respectively, and both made an uneventful recovery from this cooling. The heat regulatory mechanism presumably ceases to operate below 75°F. in animals, and the continued fall in body temperature proceeds at the same rate as that in a dead animal in similar circumstances. If the animal is then warmed the thermal regulatory mechanism begins to assert itself at approximately 75°F. In the hibernating animal the body temperature may approach 32°F. without causing death.

For induction of general hypothermia Talbot recommends three or more grains of nembutal intramuscularly twenty minutes before the patient is placed nude in the cold environment at 32°F. Just before the cooling 0.5 to 0.7 gramme of evipan is given intravenously. Within an hour the anæsthetic effect of evipan has worn off and simultaneously the body temperature falls. The anæsthetic property of the cold usually obviates the necessity for further intravenous anæsthesia or sedative. By keeping the environmental temperature below 60°F. a working range for internal temperature (controlled by rectal thermocouple) between 80° and 90°F. is maintained for not more than twenty-four hours in the trial period of treatment. This trial period is especially necessary for patients older than 40 or who have metastatic cancer. Following the initial treatment there may be one or more additional periods of from two to four days each, while the intervals between successive treatments may be as short as two or three weeks. It is not known how many times the treatment may be repeated. A gradual restoration of body temperature at a rate not higher than 2°F. an hour is associated with fewer ominous signs than a rapid rise. No serious after-effects have been observed, but the development of pneumonia in patients with metastatic cancer in the lungs is sufficiently common to cause rejection of such patients for treatment. During hypothermia there are various changes such as initial rise of pulse and blood pressure followed by a gradual fall, obliteration of venous channels, constriction of large arteries but no vascular occlusion or thrombosis, prolongation of circulation time from arm to leg, disappearance of pupillary reflexes, cardiac arrhythmias such as sinus arrhythmia and auricular fibrillation. All Talbot's patients whose temperature reached 80°F. developed fibrillation, which was corrected by digitalis, quinidine, and restoration of body temperature. Unless fluid balance is maintained there is hæmoconcentration with an increase (25 per cent) in the red cell count. The white cell count increases several-fold with a rise in the percentage of polymorphonuclear cells. Routine urine analyses for albumin, sugar, and formed elements were negative.

The principal conditions treated up to the time of Talbot's publication were intractable pain, cancer,

morphine addiction, leukæmia, and schizophrenia. Relief of pain may well be the most important gain, and all observers are in agreement concerning this; two-thirds of the patients treated had much relief. Some have found that sedatives, narcotics, and operative intervention (chordotomy and rhizotomy) for pain are no longer necessary. Morphine addiction *per se* has responded to general hypothermia, and the use of cold in diminishing the undesirable effects of alcoholic intoxication has been appreciated for at least 150 years. Talbot refers to a gentleman named Weeks who lived about that time back and was a great votary of Bacchus. For fifteen or twenty years he was in the habit of plunging into cold water when he rose from his bottle and of actually going to sleep in a trough full of water with his head specially supported. Instead of experiencing debility, lassitude, headache, and nausea, he found himself on awaking cheerful, refreshed, and free from all effects of intoxication.

The value of greatly reduced temperatures in other fields of surgery is also being studied by Dr. F. M. Allen of New York and others. Fundamental investigations are being very carefully conducted in order that undue enthusiasm over a spectacular novelty may not be followed by disillusionment, which may obscure any real value of the method. Dr. Allen introduces the use of the tourniquet with low temperature and gives some data of amputations through the thigh and the lower leg for diabetic gangrene and arteriosclerotic gangrene in aged patients; anaesthesia is produced by keeping the bloodless leg tissues for a period of from one to five hours at a temperature of about 5°C. by means of ice-bags or iced water. The leg is rendered bloodless before cooling by careful application of a narrow tourniquet after elevation of the leg to drain off any non-infected blood. The use of cold makes it possible to disregard the rule that a tourniquet must not be applied to a diabetic or arteriosclerotic limb. The tourniquet is released after the operation, when all is in readiness for closure of the wound. It appears that both primary and secondary shock are abolished by suitably low temperature in the damaged tissue, and the surgeon has the opportunity of working in a bloodless and shockless field; the low temperature inhibits growth of bacteria. Loss of vitality in wound flaps or mutilated tissue is also treated by local reduction of temperature, as is post-operative shock. Healing is slowed down but not stopped by low temperature. Attention is also being directed towards the possible use of hypothermia in military surgery and in embolism and other accidents. Embolism of a main artery is one of the conditions in which warming a limb is disastrous, and Dr. Allen believes that a suitable degree of refrigeration may be the most important non-operative treatment. At a temperature of 5°C. the requirements of the tissues for oxygen are reduced, and in intact animals the period of survival of the bloodless limb tissues has been experimentally increased at least to fifty-four hours as against the few hours or minutes at higher temperatures. Dr. Allen has attempted to apply this finding to surgery, but at present his researches are at a preliminary stage.

### First-Aid Treatment of Burns

By A. H. McINDOE, M.B.N.Z., M.S., M.Sc. (Minnesota),  
F.R.C.S., F.A.C.S.

(From the *Lancet*, Vol. II, 27th September, 1941,  
p. 377)

DURING the past year much thought has been given to the treatment of burns. This has culminated in recommendations made by the War Wounds Committee of the Medical Research Council after a prolonged survey of the results produced by various methods, under both civilian and Service conditions. It is not surprising that, considering the special causes and unusual types of burns encountered, these recommendations have modified established procedure, though not as extensively as many seem to believe. Careful

perusal of the E.M.S. pamphlet (343)\* will show that coagulation therapy, far from being condemned, remains an important method of treatment, particularly in the extensive burns of the 1st and 2nd degrees on the trunk and extremities common in civilian life, where shock and toxæmia are liable to follow. Exception was, however, taken to its use in encircling burns of the hands and feet and in other areas of functional importance, such as the face, flexures, perineum and genitalia, where experience showed that undesirable complications might follow. It was not suggested that burns of all degrees in these special areas showed equally bad results when coagulated, for many have not done so, but certainly some of the more severe burns in which function has been endangered have been further compromised by coagulants.

Most competent observers will agree that it is relatively easy to distinguish between a 1st and 3rd-degree burn, but often extremely difficult, even under the best conditions, to decide between those of the 2nd and 3rd degrees. If the surface is contaminated with dirt and oil it may be impossible to make an accurate diagnosis of any degree. This problem is much more acute at first-aid posts and advanced dressing stations, where cleansing facilities are often inadequate, light is poor, and examination is perforce superficial. When the patient is admitted to hospital the degree of involvement must be determined and the appropriate treatment decided on. It is thus vitally important that first-aid treatment should not compromise hospital treatment.

Experience shows that tannic acid is not a panacea for war burns, whatever its results in civil practice. It certainly takes its place, however, in the pattern of treatment which is being slowly evolved. This pattern has not yet reached finality. Alternative methods are still under investigation and it is not intended here to express dogmatic opinions as to their relative value. The wholesale distribution of tannic-acid preparations and vital dye coagulants to homes, first-aid posts and dispensaries has, however, created considerable confusion in the minds of many as to whether coagulants should be applied as a first-aid measure or whether other dressings should be substituted. The desire to make some sort of immediate local application to the burned area is strong, and admittedly the patient may be greatly relieved thereby. The ideal local application would be a quick-drying, flexible and elastic seal, incorporating bacteriostatic and anaesthetic agents. It should be painless to apply, and should resist, when dry, ordinary handling for two to three days without renewal and during that period prevent loss of tissue fluids and the entrance of organisms into the burned area. Especially, it should be water or oil soluble so that it can be easily removed at the hospital where adequate treatment of the burn is undertaken. Whether coagulation should be an essential part of its action is open to question.

None of the variety of suggested preparations exactly fulfils these requirements, and until the ideal substance is produced, obviously the simplest form of easily removable dressing is to be preferred. One can therefore agree with almost any coagulative or non-coagulative treatment which personal preference might dictate in the case of minor burns not requiring admission to hospital, but the first-aid application of any local treatment other than easily removable dressings to those major burns requiring hospital treatment should be discouraged. This is particularly true of those more positive coagulative agents applied hurriedly and inadequately over unclean surfaces in such a way as to be detrimental to the success of subsequent treatment in hospital. While there may be some disagreement between those who believe in universal coagulation and those who do not, they are united in the opinion that first-aid tanning of serious burns is a handicap to the definitive hospital treatment, because once they are applied the crust is difficult to remove.

The function of the first-aider is therefore, firstly, to distinguish between minor burns which do not require

\* See *Lancet*, 1941, 1, 425.



hospital treatment and to treat them efficiently; secondly to transfer major burns to the nearest hospital or burn unit as soon as possible, limiting treatment to measures of a general nature and to simple local applications, avoiding anything which may be difficult to remove.

The problem is not altogether simple, for while the majority of badly burned patients can be transported to hospital within a short time, it may be days before others can reach suitable hospital facilities. Thus first aid may be required for burns at sea or in the desert under such difficult conditions that treatment considered inadvisable where quick transport is available might be desirable where there is great delay. An attempt is being made to suggest a reasonable first-aid programme adequate for burns of various types occurring under varying circumstances.

#### MINOR BURNS

A minor burn is defined as one of the 1st or 2nd degree, covering an area not greater than 1 per cent of the total body surface—i.e., an area corresponding in the adult to one side of the hand or about 28 square inches. It should not involve any of the special areas already mentioned: the hands, face, feet, flexures, perineum and genitalia. Shock is not in evidence and sepsis is uncommon. Pain is usually severe. Healing is rapid by regeneration from the undamaged portion of the skin, whatever local application is used.

*General treatment.*—If pain is not controlled by aspirin or veganin, then morphine gr. 1/6—1/3 should be given (for an adult).

*Local treatment where cleansing facilities are available.*—Since these burns are not sent on to hospital, first-aid treatment is as a rule definitive. Whatever is applied should be regarded as the final dressing. Some form of coagulant is therefore safe, simple and satisfactory. Coagulation seals the surface, abolishes pain, prevents secondary infection, and enables the patient to carry on with his work within a short time.

If the burned area is likely to be contaminated, it should be carefully and gently washed, together with the surrounding skin, with soap and water. An application is then made of one of the coagulants in tube form, usually available at most first-aid posts, such as Tannafax, Amertan, gentian-violet jelly, or triple-dye jelly. It is either smeared directly on the burn or applied on a single layer of lint or gauze. Alternatively, the surface may be daubed with 10 per cent tannic acid, 5 per cent silver nitrate, or both, or painted with gentian violet 2 per cent or triple dye (gentian violet 1/400, brilliant green 1/400, neutral acriflavine 1/1000). If tannic acid or silver nitrate is used no dressing should be applied over the burned area.

Non-coagulant dressings may also be used, such as Vaseline gauze, tulle gras, ambrine, or soft paraffin, but care must be taken to ensure the sterility of the dressings. If sulphanilamide powder is liberally sprinkled over the burn before their application the risk of sepsis will be negligible, and possibly the rate of epithelialization greater than with coagulant dressings. It is certainly true of the sulphanilamide, tulle gras, saline sequence now in wide use. Nevertheless, the coagulants have a decided advantage over non-coagulant dressings as a first-aid dressing for minor burns, in that once applied they do not require renewal or much aftercare and are not so liable to contamination from outside sources.

The newer preparations, such as euglamide, a paste incorporating albucid and a local anaesthetic, and the water-soluble jellies containing sulphanilamide alone or in combination with an antiseptic, have given good results but are not altogether suitable for first-aid purposes, because of their messiness and inability to remain *in situ* for long.

*Local treatment where cleansing facilities are not available.*—Not infrequently, burns of this type are badly contaminated with oil or dirt, under such difficult conditions that adequate cleansing facilities are not at hand—for instance, at a thoroughly disorganized first-aid post, where the water has failed, in the desert, or at

sea in an open boat. If any form of cleansing is impossible, it is foolish to coagulate a heavily contaminated burn of any type, and thereby seal up organisms on the damaged surface. In any case, the presence of oil will prevent coagulation. It might be pointed out that in the desert where mechanical transport is usually near, benzene or petrol are excellent cleansing agents and are also practically painless when applied to injured surfaces. Under such circumstances, one of the non-coagulant dressings should be used, and if flies constitute a menace the whole area can be sealed off with a piece of oiled silk, or, if it is available, enclosed in a Bunyan-Stannard envelope. At sea, failing all else, a compress of sea water would be excellent provided it was kept wet.

#### CLASSIFICATION OF MAJOR BURNS

Burns of any greater extent or depth than minor burns or any burns of the hands, face, flexures, genitalia or perineum should be regarded as of major importance and dispatched to the nearest hospital or burn unit as soon as possible. As opposed to minor burns, the first-aid problem centres round the patient's general condition and the question of how soon he can be transferred. Local treatment is of secondary consideration except under unusual circumstances, and should be concerned only with the protection of the burns from further trauma and secondary infection. Major burns may be classified as follows:—

(a) Major burns without serious shock where transport is available. These form the majority of war burns and are easily dealt with.

(b) Major burns with serious shock rendering transport dangerous. There are very few cases of this type. They become noticeably fewer the greater the experience of the observer and the more prompt the transport arrangements.

(c) Major burns with or without shock, occurring in situations where transport is delayed or is not available. With severe shock every moment which passes before the administration of plasma or serum increases the risk to life. Hence it is better to undertake a difficult journey than to allow blood-volume to fall and hæmoconcentration to rise. Naturally these are difficult problems and much depends on local facilities, mode of transport and distance to the nearest hospital.

#### SHOCK

Although shock has been divided into primary and secondary forms the former is not commonly seen; if it does occur it resembles a fainting attack due to neurogenic and traumatic factors. It usually passes off quickly under the influence of rest, heat and morphine.

True burn shock (called secondary shock) has all the characteristic signs of ordinary wound shock—rising pulse-rate and respiration-rate, pallor, thirst, anxious restlessness, falling blood-pressure, and so on. It must always be regarded as serious, for it is responsible for 60 per cent of all deaths from burns. It may appear within an hour of injury but does not usually show itself for six hours or more. During this time the patient feels and looks well and may even have walked several miles to a dressing station with burns of the most extensive type. This is common in Service casualties. The detection of incipient shock in such cases is difficult without hæmoglobin estimations but the possibility of its clinical development, either slowly or suddenly, must always be borne in mind. Shock results from failure of the circulation in the face of hæmoconcentration and falling blood-volume. The 'trigger' which usually induces it is rapid loss of body heat from exposure to cold or further trauma to the already injured skin surface. Undressing the patient to examine the burns in first-aid posts, or any rough handling of burnt areas, should therefore be sedulously avoided. As a rule there is a relatively safe period in the first six hours in which the patient, though severely burned, can stand a reasonably long journey (20 to 30 miles) by road ambulance. There are few cases to which this does not apply. The patient may suddenly become shocked during transfer, but this is not necessarily the result of the journey.



It would probably have happened anyhow. The likelihood of shock supervening rapidly may be judged from the extent and situation of the burns, but as it is dangerous to undress a burned patient, only a very rough estimate of this can be made. In general, shock is liable to be serious if more than 25 per cent of the body surface is involved. In estimating this percentage the following table may be useful:—

|            | Per cent |                       | Per cent |
|------------|----------|-----------------------|----------|
| Head ..    | 6        | Entire front of trunk | 19       |
| Both hands | 6        | Entire back of trunk  | 19       |
| Both arms  | 18       | Thighs ..             | 19       |
| Lower legs | 18       | Feet ..               | 6        |

Burns of the face, precordial area and abdomen are more dangerous than those of the arms, legs or back. The depth of the burn is not so important as its extent.

If for any reason there is delay at the first-aid post and shock is feared, the pulse and respiration should be noted every half hour, and the B.P. taken as often as possible. With burns of the hands and arms this may be impossible.

#### GENERAL TREATMENT OF MAJOR BURNS

**Pain.**—All patients with major burns should receive a full dose of morphine immediately ( $\frac{1}{2}$ — $\frac{1}{4}$  gr. for an adult). Anything less is futile and the dose can be repeated. Many patients with severe burns are not conscious of pain until the shock phase is over but moderate burns without shock are usually extremely painful.

**Shock.**—If this is likely to occur while waiting for transport to arrive the patient should lie down on a stretcher or cot and be covered with blankets, with hot-water bottles to keep him warm. Unless the clothing is soaked in water or other fluids it should not be removed, and then only if something warmer can be substituted. Hot sweetened drinks such as tea or coffee should be given freely. Plasma or serum injection is rarely possible or advisable in first-aid posts, and if required should be obtained by means of a mobile unit from the nearest hospital. Rapid transfer of the patient to the hospital is certainly the better plan. In the Services, all station sick quarters, many advanced dressing stations and some ships are suitably equipped for intravenous therapy in the places where delay in transport is likely. Plasma should be used wherever it is indicated. The usual preliminary dose is two bottles of dried plasma or liquid human serum given according to M.R.C. Memorandum No. 1. This may in serious cases be increased to ten or twelve bottles.

#### LOCAL TREATMENT OF MAJOR BURNS

Major burns should not be coagulated as a first-aid measure. The local conditions are almost always totally unsuitable for this procedure and in the majority of cases more harm than good will be done. Burns on exposed parts dispatched forthwith to hospital should be powdered with sulphanilamide and covered with a sterile towel or wet compress of sodium bicarbonate or saline. Since contact with air is painful the burn surface may be more efficiently protected with simple vaseline gauze strips or tulle gras over the layer of powder. The Bunyan-Stannard oilsilk envelope is a useful added protection during transport, and indeed may be used alone for this purpose.

The problem of the burned patient when transferred to hospital will be delayed for days—e.g., at sea, in the desert or in isolated spots—is difficult, and will depend on the facilities at hand and the severity of the burn. For the patient's comfort it may be necessary to coagulate the whole area, in which case the vital dyes or silver nitrate 10 per cent, which are themselves antiseptic, are most suitable. It will be best to avoid an anesthetic if possible, for this will undoubtedly increase the risk of shock. Flies will usually constitute a major danger, hence the oilsilk envelope will have considerable value. First-aid treatment in these circumstances will constitute an unhappy compromise between what is possible and what should be done.

## Reviews

**MEDICAL DISEASES OF WAR.**—By Sir Arthur Hurst, M.A., D.M. (Oxon.), F.R.C.P. Second Edition, 1941. Edward Arnold and Company, London. Pp. viii plus 427. Illustrated. Price, 18s.

THE second edition of this excellent book is very welcome, especially when the major portions of the British and Allied Nations' armies are in training, and are waiting, rather than in action, and are therefore far more likely to need the attention of the physician than the surgeon.

The title has been liberally interpreted, and the book includes a wide range of medical diseases; pediatrics and gynaecology naturally find no place in this book, but, in view of the number of women now in the active services, one wonders whether a chapter on the latter subject will not find a place in some subsequent edition.

Trench fever is given disproportionate attention. We have not heard that it has appeared again in this war, but one presumes that the material on which the account is based was handy—and it is certainly a very good account of the disease—so it was presented. One would have appreciated some data on heat stroke which, one feels, the campaign in Libya must have provided.

The accounts given of tropical diseases, such as malaria and the dysenteries, and their treatment, are thoroughly sound and remarkably comprehensive for the space in which each is contained.

There is a good chapter on epidemic jaundice, in which leptospirosis is given pride of place, but other epidemic jaundices which are sometimes forgotten are given suitable prominence. One wonders why the author adheres to the obsolete *Leptospira ictero-haemorrhagica*.

It is a book that we can very strongly recommend to the new, or to the experienced, service doctor. We must also comment on the very high standard of book production that is still being maintained in England in the face of great difficulties.

**AIDS TO PATHOLOGY.**—By Kenneth Campbell, O.B.E., M.B., F.R.C.S. Eighth Edition. 1941. Baillière, Tindall and Cox, London. Pp. viii plus 261, with 12 illustrations. Price, 5s.

THIS is the eighth edition of the book since its first appearance in 1907. The author should be congratulated in his attempt to incorporate most of the subject in a small volume of two hundred and sixty-one pages. There are of course limitations in a publication like this which aims at presenting the subject in a short and concise form. The author has very wisely drawn attention to this fact in the preface.

In the chapter on 'Nature's defences' the author has dealt with agglutinins and precipitins, etc., in a few lines. It is worth considering whether this sort of inadequate discussion on immunological reactions will not create confusion in the minds of students and would not be better left out altogether. In discussing the mechanism of infarction the writer says 'much controversy has taken place on this still debatable question, which after all is of trifling importance except to pedants'. The author will find support from many pathologists to his contention.

*Aids to Pathology* will be of much use to students while revising the subject. Considering the vastness of the subject which has been compressed into the small size of the book, this volume is bound to be very popular with the student who wants to acquire a cut-and-dried knowledge of the subject.

B. P. T.

**OPHTHALMIC NURSING.**—By Maurice H. Whiting, O.B.E., M.A., M.B., B.Ch. (Cantab.), F.R.C.S. Third Edition. 1941. J. and A. Churchill Limited, London. Pp. xiv plus 167, with 54 illustrations. Price, 6s.

THIS is the third edition of this book and it has been brought up to date by the introduction of sulphonamide

and the other kindred drugs in the treatment of bacterial infections and their application in the treatment of diseases of the eye. A short section has also been added dealing with gas burns of the conjunctiva and the eyeball.

The book consists of 157 pages divided into 14 chapters and is based upon the practices adopted at Moorfield's Eye Hospital, London. The book is excellent, written in simple style and well provided with illustrations. In India, where so much eye disease prevails and where so many thousands of operations on the eye are performed, the book will not only be found most helpful and useful but indispensable. Good ophthalmic nurses are few and far between and many nurses complete their training without much experience in the nursing of eye cases. The teaching advocated by the author is on the whole suitable for India except that bandaging of the eyes has been given up and replaced by fine strips of sticking plaster applied over the dressing. In cataract operations both eyes need only be covered for one day and not as advocated by the author for three or four days. Morphia after intra-ocular operations is better avoided owing to the danger of it causing vomiting. The best eye shield is the Kirkpatrick celluloid one and far more satisfactory than the Fuch's or cartella shields advocated by the author. The Guist operation of chemical cauterization is now obsolete.

We strongly recommend the book not only to nurses, but also to house surgeons and medical men interested in ophthalmology in India.

E. O'G. K.

#### THE MEDICO-LEGAL POST-MORTEM IN INDIA.—

By D. P. Lambert, M.D., Ch.B., D.T.M. & H. (Univ. Edin.). Second Edition. 1941. J. and A. Churchill Limited, London. Pp. vii plus 113. Price, 5s.

MAJOR D. P. LAMBERT'S *'The Medico-Legal Post-mortem in India'* is a nice little compilation which will be of immense practical importance to the students and a very useful guide to the doctor in the post-mortem room.

The little book contains seventeen chapters and though each chapter has to its credit some very excellent and reliable information unfortunately the seven concluding chapters are unusually short. He has given a very typical and vivid description of the bodies generally found in various stages of decomposition in the post-mortem rooms in India.

In my experience in Bengal the way in which bodies are usually sent for post-mortem examination is not very satisfactory, as they are tightly bound down from head to foot after being wrapped in a *chatai* (mat) and thickly covered with charcoal powder to prevent decomposition. This procedure adds insuperable difficulties in the identification of the various kinds of wounds in them and in assessing their values in a court of law. I think mention should have been made of this point.

Of the earlier chapters that on gun-shot wounds is considered to be an excellent one as it contains clear and practical elucidation of them which are not met with in many textbooks.

Of the concluding chapters, those on electrical injuries and abortion could be profitably enlarged to some extent in spite of the fact that Major Lambert has resisted all temptations to do so.

As an examiner I can only say with emphasis that this book should be the constant companion of all students who enter the post-mortem room to get a preliminary knowledge on this subject.

The get-up of the book is nice and handy and the subject-matter has been expressed in very lucid language without any ambiguity.

L. G. B.

**ACCIDENTAL INJURIES: THE MEDICO-LEGAL ASPECTS OF WORKMEN'S COMPENSATION AND PUBLIC LIABILITY.**—By Henry H. Kessler, M.D., Ph.D., F.A.C.S. Second Edition. 1941. Henry Kimpton, London. Pp. 803. Illustrated with 202 engravings. Price, 45s.

The title of this book is rather misleading, as it does not deal with the treatment of such injuries. A subtitle given on the title page 'The Medico-legal Aspects of Workmen's Compensation and Public Liability' is much more expressive of the scope of the work.

It has been primarily written for the guidance of medical referees in the assessment of workmen's compensation, a purpose which it fulfils admirably. The information given regarding the general prognosis, period of incapacity, sequelæ and permanent disability of injuries is authoritative and well-described, and useful statistics are given. This information is probably not available in any other single volume, and for this reason is likely to have value beyond the original intentions of the author in being of assistance to those who will have to assess the disabilities, both military and civil, due to enemy action in the present conflict.

It is scarcely necessary to point out that the legal rulings and percentage of disabilities quoted are based on American court rulings, and must be modified in accordance with the law and practice of this country.

J. C. D.

## Abstracts from Reports

**TRIENNIAL REPORT ON THE WORKING OF THE CIVIL HOSPITALS AND DISPENSARIES IN THE PROVINCE OF ASSAM FOR THE YEARS 1938, 1939 AND 1940.** BY LIEUT.-COLONEL A. M. V. HESTERLOW, M.B., Ch.B. (EDIN.), B.Sc., P.H. (EDIN.), D.T.M. & H. (EDIN.), I.M.S., INSPECTOR-GENERAL OF CIVIL HOSPITALS, ASSAM

### RESOLUTION

DURING the triennium the number of hospitals and dispensaries of all classes rose from 281 to 305.

The total number of indoor and outdoor patients treated at medical institutions decreased from 6,567,717 in the previous triennium to 5,990,774. The decrease was confined to the districts of Sylhet, Kamrup, Goalpara, Nowgong and Sibsagar. In other districts there was increased attendance. The variations are ascribed to differences in general healthiness and incidence of malaria in the districts concerned.

The total number of beds provided in all classes of hospitals rose from 1,797 in 1937 to 1,943 in 1940.

In spite of financial stringency, there was some improvement in accommodation. The Mokokchung Civil Hospital secured accommodation for 22 more beds and the Sylhet Civil Hospital for 16 more beds. An additional block of 26 beds for male patients was provided at the Tezpur Mental Hospital, at a cost of Rs. 15,500.

The department's effort to raise the standard of local institutions was greatly assisted by gifts made by public-spirited people. At Tinsukia the construction of a modern hospital, at an estimated cost of Rs. 44,000 given in full by the late Babu Surajmall Jalan of Tinsukia, was started and is nearing completion. At Dibrugarh Civil Hospital, two special female wards of 4 beds each are being built. For these a gift of Rs. 6,000 was made by Babu Mohanlal Ajitsaria, on condition that the wards should be called the 'Rautmall Wards' after his late father. At Maulvibazar a new dispensary building, a maternity ward, a female ward, nurses' quarters, a leprosy clinic, and other accessories were provided by public donation, including a gift of Rs. 2,500 made by Babu Gagan Chandra Sen for the female ward. In Kohima, the Naga Club contributed

Rs. 1,150 towards the construction of an operation room. *Kala-azar*.—The total number of cases treated in 1940 in dispensaries other than those directly under the Public Health Department was 10,735 against 8,702 in 1939 and 8,775 in 1938. Increased efforts are being made to combat this disease.

*Leprosy*.—The leper hospitals and asylums continued as before. An inquiry was made by an officer of the British Empire Leprosy Relief Association in 1940, and Government are considering the need for certain changes as a result of his report. Twenty-seven Public Health Officers were trained in leprosy treatment, and propaganda was carried on with magic-lantern demonstrations and lectures.

*Malaria*.—The total number of cases treated during the triennium was 2,143,008 against 2,146,726 in the previous triennium. Ten malaria surveys were done by the Malaria Research Society—four in tea gardens, four in Government areas, and two on behalf of other constituents of the society. Twenty-seven doctors attended the annual eight-week course in malariology. Technical guidance was given by the society for anti-malarial operations in eighteen centres under Government and for other such operations in tea gardens where survey was carried on. In all these areas the good effects were noticeable.

During these three years there was some lack of quinine, which is attributed partly to the exhaustion of the free gift of quinine made by the Government of India and partly to the lack of adequate provision by local bodies. Government express the hope that local bodies will not reduce their own provision in the expectation that deficiencies will be supplied by free gifts from other sources. At the same time they are trying to improve the supply of quinine and cinchona febrifuge, though the war has brought increased difficulties.

*Smallpox*.—The number of cases treated in 1940 was 116 against 35 in 1939 and 97 in 1938.

*Cholera*.—The number of cases treated fell from 3,027 in 1938 to 458 in 1939, and then rose in 1940 to 963.

*Tuberculosis*.—Anti-tuberculosis propaganda was carried on as in the previous triennium. The Tuberculosis Association of Assam was formed in 1939 and took over the work of the authorities in charge of the King George Thanksgiving and King Emperor's Anti-Tuberculosis Funds. The new association has begun to plan for organized work in the province, taking over the Shillong Chest Clinic. There were several improvements in accommodation, staff and the training of doctors, and there is now a project for a tuberculosis clinic and hospital at Shillong.

*Gaitre*.—The disease was prevalent throughout the province, especially in Goalpara, the Naga Hills, and Lakhimpur. Extensive experiments with iodized salt were carried out in the Naga Hills, and the results are reported to have been good.

*Subsidized dispensaries*.—In an effort to make medical relief more extensive, Government sanctioned 27 such dispensaries, of which 15 were working at the end of 1940. The system is still in an experimental stage, and Government are considering the various problems involved, with a view to improvement.

*Nurses*.—The need for trained midwives, nurses and health visitors is engaging Government's attention. The Sisters of Charity continued their excellent work at the civil hospitals of Sylhet, Gauhati and Dibrugarh.

#### REPORTS ON THE WORKING OF MUNICIPALITIES IN BENGAL DURING THE YEAR 1939-40

The municipal authorities generally showed considerable interest and energy in matters relating to public health and sanitation in their respective areas. There was, however, a slight decrease in the expenditure on account of the municipal health officers and sanitary inspectors which fell from Rs. 2.43 lacs to Rs. 2.41 lacs, while the total outlay on hospitals and dispensaries and on other sanitary measures also fell from Rs. 4.76 lacs to Rs. 4.66 lacs and from Rs. 1.49 lacs to Rs. 1.34 lacs, respectively.

Cholera and smallpox broke out in epidemic form in a few municipalities but were mostly brought under control by the timely adoption of preventive measures. The Public Health Department also sent their experts to help in dealing with the situation in Naihati and Bhatpara municipalities arising out of an epidemic of smallpox. Sporadic cases of cholera and smallpox occurred, as usual, in several towns but were generally promptly dealt with by the municipal authorities.

A permanent staff of vaccinators was maintained by most of the municipalities and free vaccination was given as usual, at fixed stations and, in some municipalities, also at the houses of the rate-payers.

Anti-malarial measures on approved lines were adopted by a number of municipalities. The Bally municipality carried out anti-malarial work in co-operation with the East Indian Railway administration at Lillooah with the result that there was practically no malaria during the year and the general public health was good. An experimental five-year anti-malarial scheme, financed from grants from Government and the Rockefeller Foundation in equal shares and covering the town of Jessore and its environment, was undertaken by the Public Health Department and fair progress has been made in checking the disease. Anti-malarial measures were conducted by the staff of the Dacca anti-malarial committee, an independent organization supported by contributions from Government, the District Board, the University, the Dacca Club and from other sources. The work of the committee was of great benefit to the Dacca municipality. As in previous years, most of the municipalities took steps to improve the general sanitation of the towns by cutting down roadside jungles, disinfecting tanks and ditches, and by issuing notices to private persons for clearing their lands of weeds, jungles and other insanitary vegetation.

Anti-rabic treatment was undertaken, as usual, by several municipalities. Special arrangements for the treatment of kala-azar and leprosy were made by the municipalities of Krishnagar and Nawadwip. Krishnagar maintained a tuberculosis clinic and Nawadwip carried on anti-tuberculosis propaganda in every school in order to guard against the disease. The leprosy clinic at Berhampore also worked satisfactorily. At Kurseong, 60 new cases of tuberculosis were detected by the health visitor during the year under review and the persons affected were either removed to hospital or given necessary instructions.

Municipal authorities were also not unmindful of their duties in regard to maternity and child welfare. Several municipalities organized *dai*-training classes—the *dais* being supplied with necessary equipment after the completion of the usual course of lectures and practical training. A maternity centre was established at Hooghly-Chinsurah and the Narayanganj Mahila Samiti organized an exhibition with the co-operation of the district board.

An x-ray ward at an estimated cost of over Rs. 15,000 was under construction in the Sardar Hospital at Comilla and for this purpose a donation of Rs. 12,500 was received from Mr. A. C. Sen of Chunta.

The administration of the Food Adulteration Act continued to be uneven and inadequate as in the preceding years in almost all municipalities, except a few in which the municipal authorities showed commendable vigilance and energy in detecting and prosecuting the dealers in adulterated foodstuffs.

#### ANNUAL REPORT OF THE MALARIA ADVISORY BOARD, FEDERATED MALAY STATES, FOR THE YEAR 1940. By A. NEAVE KINGSBURY, CHAIRMAN

We received this report just after Kuala Lumpur had fallen into enemy hands so it was with a feeling of sadness that we read this record of hard work for the year and plans for the future.

The fine results in malaria control achieved throughout the Federated Malay States, many of which are recorded annually in the report of the advisory board, must necessarily receive a complete setback and when peace once more becomes established, work will have

to be commenced once more from the beginning. Let us hope that this will be soon and that the members of this board are all safe so that as soon as the opportunity occurs they can resume their rudely interrupted task.

# ANNUAL REPORT OF THE DIRECTOR OF THE PASTEUR INSTITUTE OF SOUTHERN INDIA, COONOR, TOGETHER WITH THE THIRTY-FOURTH ANNUAL REPORT OF THE CENTRAL COMMITTEE OF THE PASTEUR INSTITUTE ASSOCIATION FOR THE YEAR 1940-41

## ANTI-RABIC TREATMENT

DURING the thirteen months under review, 16,710 courses of anti-rabic vaccine were prepared and issued under the revised system of treatment. Of these, 1,181 courses were issued during December 1939, and the remaining 15,529 courses during the calendar year 1940.

During the period under review, 355 patients received a complete course of anti-rabic treatment at the Institute (346 Asiatics and 9 Europeans). Incomplete courses of treatment were also given to 36 patients, of whom 12 were absolved from further treatment after the possibility of rabies in the biting animal had been excluded. The remainder absconded.

The treatment given at the various subsidiary centres was similar to that administered at the Pasteur Institute, Coonor.

The various centres returned 14,973 case cards for patients treated during the period under review. Of these, 11,415 received a complete course of treatment and 3,450 were incompletely treated. The remaining 108 were absolved from further treatment as the possibility of rabies in the biting animals was excluded.

Only 31 deaths were recorded among the 14,865 patients who received complete or incomplete courses of treatment, giving a mortality rate of 0.20 per cent.

Anti-rabic vaccine was also made available for the prophylactic treatment of animals. While it is advocated that dogs should be protected before they are exposed to infection, it is found in practice that treatment is comparatively seldom given until the animal is at risk. During the year, 30,940 c.c. of 5 per cent carbolized sheep-brain vaccine were issued for the treatment of animals, chiefly to the veterinary officers in the Madras Presidency and neighbouring Indian States. The number of animals treated during the year was 494 of which 438 were dogs.

Routine laboratory examinations were carried out on a large scale for the benefit of hospitals, dispensaries and practitioners. The total number of examinations carried out during the year was 2,300. Most of this was done free of charge, but fees were recovered at schedule rates from patients who were in a position to pay, except in the case of Government servants.

## NUTRITION RESEARCH LABORATORIES (Indian Research Fund Association)

Director, Dr. W. R. Aykroyd, M.D., Sc.D.

In the 1939-40 Report of the Director of the Pasteur Institute of Southern India a general account was given on the development and activities of the Nutrition Research Laboratories, which enjoy the hospitality of the Institute. The note in this year's report deals only with developments during the current year.

*The analysis of foods.*—One of the most important activities of the laboratories is the study of the nutritive value of Indian foods. Most common Indian foods have been analysed within recent years for their content of protein, fat, carbohydrate, calcium, phosphorus and iron. The most recent addition of Health Bulletin No. 23, 'The Nutritive Value of Indian Foods and the Planning of Satisfactory Diets', contains nearly 300 analyses of different foodstuffs. Though much work has been carried out in this field, considerable gaps in our knowledge remain, particularly with regard to the distribution in foods of certain vitamins. The laboratories have for some time past paid particular attention to the B group of vitamins, which are of great importance in human nutrition, and particularly so in

India where the usual type of diet consumed by the poorer classes tends to be deficient in one or more of these essential food factors.

Chemical tests for nicotinic acid, vitamin B<sub>2</sub>, and flavine, which are all important members of the B<sub>2</sub> group of vitamins, have been devised. These have been applied in the analysis of foodstuffs and in other directions. In general the B<sub>2</sub> group is found in most abundant quantity in milk, meat, eggs and fish, and is present in smaller quantities in vegetable foods such as cereals, pulses, vegetables and fruits.

As a result of the war, imports of cod-liver oil into India have practically ceased. Cod-liver oil is of value because it is a rich source of vitamins A and D. Vitamin-A deficiency is extremely common in most parts of India; keratomalacia, a destructive eye disease caused by lack of vitamin A, is one of the commonest causes of blindness in South India. Failure of cod-liver oil supplies would be a serious matter for India if a substitute were not available. Fortunately substitutes are available in the form of liver oils obtained from fish caught in Indian waters. The liver oil of the shark and saw-fish is considerably richer in vitamin A than that of the cod. The laboratories have carried out numerous tests of the vitamin content of Indian fish-liver oils, and have thereby helped in the creation of a local industry for the production of cod-liver oil substitutes. At the present time substitutes, mainly based on shark-liver oil, are being used all over the country.

*Animal experiments.*—A large stock of rats is maintained for use in nutritional experiments. The stock usually amounts to some 700 animals. These are fed on a diet devised some years ago by Sir Robert McCarrison which consists of whole wheat chapatties, butter, leafy vegetables, carrots, a little meat and whole milk *ad lib*. On this diet the animals thrive and disease has been eliminated from the colony. An abundant supply of young rats for experimental purposes is always available. During the year a number of growth experiments on rats has been carried out to test the nutritive value of various Indian diets and the metabolism and excretion of various vitamins have been studied in rats fed on various experimental diets. The rats were also employed in staging demonstration experiments for the nutrition class.

The laboratories include a pathological department, and within recent years numerous studies of pathological changes occurring as the result of food-deficiency diseases have been made. Monkeys fed for considerable periods on poor rice diets showed a high mortality from chronic diarrhoea and in such monkeys atrophic changes in the lower third of the small intestine, sometimes accompanied by mild inflammatory lesions in the large intestine, have been observed consistently. Recently a worker in East Africa has described a condition in human beings resulting from dietary deficiency which appears to be identical, as regards pathological changes, with that observed in the monkeys here. It is hoped to extend this investigation by the pathological study of human material in India. At the present stage the results of the investigation suggest that the nutritional element is of importance in connection with the high mortality from dysentery and diarrhoea in India.

## DEFICIENCY DISEASES

*Night-blindness*, or inability to see in a dim light, may be one of the results of vitamin-A deficiency. The dark adaptation curves of cases of clinical night-blindness were determined by an apparatus of the Birch-Hirschfeld type constructed in the laboratories. As compared with normal controls these showed a greatly decreased rate of adaptation and a raised final visual threshold. The administration of 216,000 international units of vitamin A in a single dose (Prepalin) brought about a change in the dark adaptation curve within 6 hours. Within 48 hours the curves had returned to normal and the patients themselves recorded the improvement in their vision in restricted light. Two of these cases had previously been treated with relatively small amounts of vitamin A through the medium of cod-liver oil without striking or rapid improvement so that a high

dosage of vitamin A appears to be necessary if immediate effect is to be obtained.

**Infantile beri-beri.**—In all Eastern countries, apart from India, in which beri-beri is prevalent, the disease is known to be common among infants. It usually attacks breast-fed infants at about the third month of life, and is often fatal. Infantile beri-beri has not, however, been reported in India. During visits to the Northern Circars the opportunity arose of observing clinically, infantile cases which were unquestionably of this nature and this gave rise to the suspicion that infantile beri-beri, though generally unrecognized, may be a serious problem in this area. The study of infantile mortality in various towns in the beri-beri area showed that there was a striking peak in mortality at about the third month of life. This is a public health finding of considerable interest and importance. There is little doubt that the heavy mortality at this period of life is due to vitamin-B<sub>1</sub> deficiency, and suitable preventive measures might do much to reduce infantile mortality in the beri-beri area.

**Superficial keratitis** due to flavine deficiency has been studied in the Government Ophthalmic Hospital, Madras. This very common condition responds very rapidly to injections of pure flavine.

Studies on *anæmia* have been carried out in Coorg, and in the same area an investigation of tropical ulcer, in the causation of which malnutrition probably plays a part, has been undertaken.

**Training course.**—The usual training course in nutrition was given during the months of April, May and June. The class included 26 members from all over India and a few visitors staying in Coonoor for the season attended some of the lectures. This is the fifth annual class and the course now follows well-established lines.

**Vitamin-C preparations.**—An important activity during the year has been the manufacture of vitamin-C preparations from the *Amla* or Indian gooseberry (*Phyllanthus emblica* Linn), for military use. *Amla* is the richest known source of vitamin C and the dried and powdered pulp of the fruit remains a very rich source of the vitamin for many months.

**Bulletins.**—A new edition of *Health Bulletin No. 23*, 'The Nutritive Value of Indian Foods and the Planning of Satisfactory Diets', has been prepared during the year. This is the third edition of this popular bulletin. A bulletin, 'Food Diet', written for children, is now under preparation. It is hoped that this will be widely used in schools throughout India. *Health Bulletin No. 28*, 'Rice', is a popular summary of a scientific monograph entitled 'The Rice Problem in India'.

## TWENTY-SIXTH ANNUAL REPORT OF ST. DUNSTAN'S, LONDON, FOR THE YEAR ENDED 31ST MARCH, 1941. ISSUED BY THE EXECUTIVE COUNCIL OF ST. DUNSTAN'S, LONDON

The report mentions that many of the instructors at St. Dunstan's were themselves, as was Sir Ian himself, blinded in the Great War. They are splendid instructors and set a most valuable example to their young blinded pupils.

'Talking about these young people', Sir Ian continues, 'we older men agreed as to their serious, thoughtful outlook and we also felt quite sure they were much better educated than we were. We thought we did pretty well when we came back from France, or Flanders, or Gallipoli, and found our way around in our new world of darkness, but we have been surprised at the speed with which the new St. Dunstaners are learning to be blind. Within a few days they are walking about the wards and classrooms; and within a few weeks the grounds and the way to the village (Church Stretton) are familiar. They do not shuffle along with a tapping stick like the proverbial blind man of ancient times, but walk erect and fearlessly, and try to look and behave as normally as possible.'

In learning braille reading and typewriting, many have passed already the severe and accurate tests which are their first qualifications as trained blind men. They learn to play, also, many indoor and outdoor games and recreations—cards, dominoes, a debating society,

concerts, goal-kicking, tug-of-war, rowing, walks, treasure hunts, tandem cycling, amateur dramatics, music and dancing are great fun and an important part of re-education. 'The great thing', he says, 'is to learn to do everything you possibly can without your sight and enjoy it.'

There is a massage class, a telephone switchboard operating class, a variety of handicrafts. The last mentioned may lead to greater things, for it is hoped some of the craftsmen will become sufficiently expert to be placed later in munition and engineering works. 'Already a number of blinded soldiers in the Great War, now in their forties, anxious to lend a hand in the war effort, are undertaking gauging, sorting, packing, machine-minding, and other jobs in factories.'

Some will become shopkeepers. One blinded young man has already returned to business as a branch manager. Another has started his training as a solicitor. A girl motor driver of the A.T.S. (F.A.N.Y.) who was a professional singer is studying to continue her work in spite of total blindness. How many men have never got out of the rut because they have never had the education and the chance? St. Dunstan's young men who are blinded have a great handicap but they will have the best education and the best chance that organization, with its twenty-five years' experience, can give them.

The report mentions the establishment of the nucleus of a St. Dunstan's Training Centre in South Africa for blinded men of the Home and Overseas Forces evacuated from the Middle East and that, with the help of the War Office and the Invalids Comforts Section of the Prisoners of War Department of the British Red Cross Society, comforts and means for preliminary re-education supplied and arranged by St. Dunstan's, for blinded men in enemy countries, were reaching their intended destinations.

More women than last time will inevitably be included in their members because women are taking a more hazardous part in the Defence Services. Among those now admitted to St. Dunstan's are members of Home and Air Raid Defence organizations, if blinded whilst on duty, for St. Dunstan's now gives its full benefits to all who are blinded in the war service of the Empire.

## Service Notes

### APPOINTMENTS AND TRANSFERS

The following appointments are made:—

#### INDIAN LAND FORCES

(Emergency Commissions)

To be Captains (on probation)

5th August, 1941

Jamshed Nasarvanji Choksy, with seniority from 15th August, 1937.

6th August, 1941

Sris Chandra Ray, with seniority from 22nd November, 1934.

24th August, 1941

Rahmat Ullah Quareshi, with seniority from 1st March, 1939.

5th September, 1941

Vaman Anant Belsare, with seniority from 13th November, 1937.

Chimanlal Maneklal Kikani, with seniority from 16th January, 1938.

William Martin D'Souza, with seniority from 24th December, 1938.

Raghvachari Rajagopalan, with seniority from 26th February, 1941.

6th September, 1941

Ram Chandra Bose, with seniority from 14th September, 1940.



5th November, 1941

Zahurul Hasan Khan, with seniority from 5th November, 1937.

The undermentioned Lieutenants (on probation) are confirmed in their rank:—

B. K. Bhadury. Dated 1st September, 1940.

27th February, 1941

C. Ibbotson. R. M. Vanreenen.

27th March, 1941

W. L. P. Spicer. H. R. Cara.

S. F. Seelig. Dated 22nd May, 1941.

O. B. Brears. Dated 29th May, 1941.

E. Dunsby. Dated 12th June, 1941.

12th April, 1941

|                  |                      |
|------------------|----------------------|
| J. Pereira.      | S. A. Sheikh.        |
| J. R. Sen Gupta. | G. L. Dutt.          |
| R. K. Garde.     | K. K. Rao.           |
| S. Agarwala.     | A. P. Banerjee.      |
| C. M. Desai.     | B. D. P. Rao.        |
| H. K. Musazai.   | R. Narasimhan.       |
| G. S. Ahmad.     | W. V. Bapaih.        |
| C. M. Patel.     | R. E. Sinha.         |
| K. P. Mukherji.  | A. A. Shah.          |
| T. George.       | D. S. Krishnamurthi. |
| C. I. Somaya.    | T. M. B. Neungadi.   |
| P. S. Bhargava.  | W. S. Raju.          |
| S. M. Dutt.      | V. Raghavachar.      |
| G. Ray.          | A. M. Patel.         |
| S. M. Dass.      | A. N. Banerji.       |
| F. M. Khan.      | T. U. Poonnen.       |
| K. A. Jabbar.    | B. N. Singh.         |
| V. B. Menon.     | A. R. Deshpande.     |
| P. Rangachar.    | S. P. Bhalla.        |

A. K. Thomas.

13th April, 1941

A. N. Subbaraman.

5th May, 1941

|                   |                      |
|-------------------|----------------------|
| M. N. Menon.      | M. C. Bhattacharyya. |
| R. R. Lal.        | R. Quraishy.         |
| S. N. Chatterjee. | M. S. Prabhu.        |
| S. B. P. Tewari.  | V. S. Ramaswami.     |
| K. S. Bagechi.    | A. Ahmad.            |
| K. Abraham.       | A. N. Ansari.        |
| J. C. Das Gupta.  | C. Arumainayagam.    |
| S. Maragathavel.  | P. F. Mathias.       |
| R. Khan.          | S. R. Kaura.         |
| G. S. Vingle.     | N. Narayen.          |
| P. C. Badhwar.    | N. K. Shroff.        |

R. S. Gupta.

6th May, 1941

H. M. Gangopadhyay. V. K. Vaidyr.

8th May, 1941

A. C. Narula.

To be Lieutenants (on probation)

25th March, 1941

Amaya Ranjan Biswas.

5th April, 1941

Edgar Arjun Ram, with seniority from 15th October, 1940.

6th May, 1941

Frank Tandy Harrington, with seniority from 31st October, 1940.

14th June, 1941

Manindra Chandra Nath, with seniority from 14th June, 1940.

5th August, 1941

Alanghatucaren Anthony Porinchu.

Mangudi Kailasa Swaminadhan.

Krishna Nand Joshie.

6th August, 1941

Alan Brownlie Gilroy.

Bernard Arthur Lamprell.

Ogilvy James Scott Macdonald.

29th August, 1941

Harbhajan Singh.

5th October, 1941

Sudhir Chandra Ghosh.  
 Narayana Kartha Gangadhara Kartha.  
 Mohan Lal Sur.  
 Faqir Mohammad Khan.  
 Ram Layak Singh.  
 Gadicherla Gagannatha Rao.  
 Unniparambath Velayudha Menon.  
 Paluri Ramchandra Rao.  
 John John.  
 Thoppil Chandy Varghese.  
 Kuttappan Nair Ramkrishnan Thampi.  
 Basheer Ahmad.  
 Chaudhary Mohammad Umar.  
 Nasim Alam.  
 Shaikh Mohammad Yunus Farooqui.  
 Walter Stephen Hart.  
 Vithalbhai Bhailalbhai Patel.  
 Bir Bal Sahni.  
 Lakshman Raghavendra Rao Lakhkar.  
 Plammood House Krishnan Pandalai Sankaran Nair.  
 Gurbachan Singh.  
 Sahdev Virmathi.  
 Mian Abdul Maqsood.  
 Maniketh Chakrapani Menon.  
 Raman Madhavan Nair.  
 Ananthacharilu Krishnaswami.  
 Alummootil George David.  
 Puthya Veetil Ramchandran.  
 Calidas Krishnaswami Ramachandar.  
 Salem Ramkrishnan Sarvothaman.  
 Melarcode-Subramaniam Krishna Murthy.  
 Thomas Devairakkam.  
 John Edwin Abraham.  
 Annaswamy Balasubramanian.  
 Siruvanur Narayanaswami Ganapati.  
 Srinivasa Ranganathan.  
 Somarowthu Rama Rao.  
 Vellore Chinnaswamy Venkatachalam.  
 Amar Kumar Ghosh.  
 Chidambara Nadar Jayaraj Aiyannadar.  
 Codanda Papanna Kariapa.  
 Namala Paul Devadason.  
 George Alexander Roche.  
 Valentine D'Costa.  
 Ariyanayakipuram Muthuswami Seshan.  
 Perumpulavil Sankara Menon.  
 Abdul Ghaffar.  
 Madduloori Wilson William.  
 Mohammad Arshad.  
 Arza Janakamohun Rao.  
 Anaikuppam Ramaswami Subrahmanyam.  
 Phiroze Jehangirji Jhaveri.  
 Krishnaswami Kalyana Sundaram.  
 Varanasi Peddavadhani Somayazulu Sarma.  
 Nayapati Vasudeva Rao.  
 Rustum Bomanji Daruvala.  
 Raymond Vivian Norman Nayadu.  
 Binay Kumar Banerji.  
 James Kanagaraj Lucas.  
 Subramonia Pillai Kumara Pillai.  
 Jayantilal Vithaldas Karia.

6th October, 1941

Dalip Shah Singh.  
 Koduvayur Matilakath Unnikrishnan.  
 Syed Qadir Bakhsh Shah.  
 Thakar Singh Chohan.  
 Haviligi Mruthyunjaya Rao.  
 Mohamad Tajuddin.

5th November, 1941

Ghyasuddin Ahmed.  
 Remanta Kumar Das.  
 Dilip Kumar Sen.  
 Manzur Ilahi Khwaja.  
 Sudhir Kumar Mazumdar.  
 Phanindra Nath Banerjee.



Surath Kumar Bhattacharjee.  
 Vishwambhar Nath Chaturvedi.  
 Vaithinathaswamy Swaminathan.  
 Krishna Pillay Mahadevan Pillay.  
 Ram Kumar Saksena.  
 Tarak Das Chatterjee.  
 Dinsukhlal Triphovandas Gandhi.  
 Kidar Nath Bali.  
 Frederick Maitland James.  
 Vinayak Santayya Achrekar.  
 Khagendra Nath Ghose.  
 Venkat Raghunath Mirajkar.  
 Aranvoil Babu Rau.  
 Pattathil Kerala Varma.  
 Parimal Chandra Banerjee.  
 Padamannore Sanjiva Rao.  
 Parvatha Reddy Chandrasekhara Reddy.  
 Balwant Sadashiv Patankar.  
 Mohammad Ikram.  
 Puthenpurail Idichandy Alexander.  
 Abraham Solomon Norman.  
 Syed Zahiruddin Ahmed.  
 Periyakulam Subramania Mudaliar Kumaravelu.  
 Asikkadu Ramanatha Natarajan.  
 Chadalavada Krishna Rao.  
 Natverlal Ratanlal Dani.  
 Pidathala Krishnamurthy.  
 Puttige Ramachandra Sastry.  
 Chakkiri Balakrishnan.  
 Jagarlapudi Subbarama Serma.  
 George Henray Durairaj.  
 Subramania Iyer Gopalakrishnan.  
 Ambalavath Kottayi Haridas.  
 Duncan John Gilbert.

6th November, 1941

Charles Frederick Seffrien Alken.  
 Thomas Bernard Maurice Sloan.  
 Chempotttil Madhava Menon.  
 Kundadak Madhav Kudva.  
 Kottappurath Mohammed Kunhi Mohammed.  
 Asirvatham Augustus Appadorai.  
 Pillalamarri Jagannatham.  
 Kaillanmar Thodi Rarukutti Nair.  
 Mandayam Devasikhamahi Ramaswami.  
 Jeevanna Rao Krishna Rao.  
 Cukkemane Ramarao Chandrashekar.  
 Vijaykant Atmaram Rane.  
 Velloor Sangameswara Sastri Ramaswami.

15th January, 1942

Phanindra Nath Banerjee.  
 Ramaswamy Nagendran.

16th January, 1942

Gella Venkata Satyanarayana Murthi.

#### PROMOTIONS

The undermentioned Indian Medical Service officer is advanced to the List of Special Selected Lieutenant-Colonels:—

Lieutenant-Colonel S. S. Sokhey. Dated 5th January, 1942.

*Note.*—The seniority of Major P. H. Cummins, to his present rank previously notified is antedated to 26th February, 1936.

#### Captains to be Majors

G. B. Thomas. Dated 1st February, 1942.  
 R. L. Haviland Minchin. Dated 5th February, 1942.

#### LAND FORCES

##### (Emergency Commissions)

##### Lieutenants to be Captains

S. F. Seelig. Dated 21st September, 1941, with seniority from 22nd May, 1941.  
 O. B. Brears. Dated 21st September, 1941, with seniority from 29th May, 1941.  
 C. Ibbotson. Dated 27th August, 1941.  
 H. R. Cara. Dated 27th September, 1941.  
 W. L. P. Spicer. Dated 27th September, 1941.  
 B. K. Bhadury. Dated 1st September, 1941.

2nd January, 1942

|                                      |                   |
|--------------------------------------|-------------------|
| B. S. Dhillon.                       | N. C. Mehra.      |
| A. A. Qureshi.                       | K. Rajamannar.    |
| M. A. Shakur.                        | S. D. N. Anand.   |
| Gopal Singh.                         | S. S. Nagi.       |
| H. Khan.                             | T. S. Row.        |
| A. H. Khan.                          | K. K. Jaswal.     |
| N. F. Shaikh.                        | M. A. K. Khokhar. |
| T. M. Asani.                         | A. R. Sethi.      |
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| D. S. Rege.                          | S. L. Abhyankar.  |
| J. Krishnamurthy.                    | A. P. Dube.       |
| T. C. John. Dated 3rd January, 1942. |                   |

#### RETIREMENTS

Lieutenant-Colonel R. F. D. McGregor, C.I.E., M.C.  
 Dated 5th January, 1942.

Lieutenant-Colonel S. C. Contractor. Dated 25th January, 1942.

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## Original Articles

### A RECORD OF *TRICHINELLA SPIRALIS* (OWEN, 1835) IN INDIA

By P. A. MAPLESTONE, D.S.O., D.Sc., M.B., B.S., D.T.M.  
and

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(From the Helminthological Research Laboratory,  
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THIS worm, according to Baylis (1939), 'appears to have been known to occur formerly in man in India, no recent references to it have been found in the literature'. Baylis does not give any authority for this apparent early knowledge of the worm in India, and at the time he was writing the book referred to he asked our assistance in tracing records of trichinella. We inquired from veterinary officers with many years' experience in the country in a large teaching school and the principal veterinary research establishment in India, and they all said they had never seen any signs of the infection in animals. These facts indicate that Baylis appears to be correct in stating that *T. spiralis* is by no means prevalent or the infections are so slight as to pass unnoticed. Based on this evidence it seems justifiable to claim the present as the first authentic record of the worm in India.

In the past few years we have conducted a systematic search of likely animals for evidence of this parasite and up to the present have examined 100 pigs, 100 dogs and 100 rats with negative results, but in the seventy-fourth cat we recently found a large number of larvæ.

**Technique.**—As the diaphragm is one of the most commonly infected muscles, this was selected for examination in every case. In the dogs, rats and cats the whole diaphragm was subjected to examination, but in pigs only a portion was taken. The muscle was finely minced, placed in artificial gastric juice and left in an incubator at 37°C. overnight. It was then put in a fine wire sieve and extracted by Baermann's technique. Hall and Collins (1937) have shown that this digestion-extraction technique is superior to direct microscopical examination of 'press' preparations when the larvæ are living, but it will not reveal dead larvæ with any certainty, as the escape of the larvæ from the sieve depends on their motility. It is therefore possible that the incidence of the infection is slightly higher than our results indicate.

This record definitely establishes the presence of *T. spiralis* in India and suggests the possibility of human infection, so a short summary of the parasitology and clinical condition, as well as an outline of the public health aspect of the problem, are set out below, because these are probably unfamiliar to most of the readers of the *Indian Medical Gazette*. At the same time

it should be borne in mind that, on the evidence presented; it is very probable that practically all the medical practitioners in the country will go through the whole period of their professional life without seeing a case.

The adult worms are small and no description of them is given, as they are never seen in a human infection and only in animals experimentally infected and slaughtered at the appropriate time. This will be clear from the life history of the worm given below.

Trichinelliasis is in some respects the most interesting of all helminthic infections because it has many of the characteristics of an acute infectious fever, even to the extent that a fatal termination is not uncommon. The manifestations of the disease will perhaps be more clearly understood if the life history is given in three numbered paragraphs corresponding with the three stages into which the course of the disease is usually divided.

**Aetiology and life history.**—1. Larval worms, encysted in pork insufficiently cooked to kill them, are swallowed, and gastric digestion weakens the cyst wall sufficiently to allow them to escape; this occurs in the duodenum. The larvæ bury themselves among the villi of the intestinal mucosa and development proceeds rapidly. By the third day sexual maturity is reached and fertilization of the female occurs. The males die and are evacuated in the stools and the females burrow through the mucous membrane gaining contact with lymphatics and small blood vessels.

2. In about three days larval production begins (eggs are not laid) and the production rate goes on rising for five or six days, after which it steadily declines and finally comes to an end in about a month. The females die and are dealt with by phagocytes. The larvæ measure about 100 $\mu$  in length by 6 $\mu$  in breadth so after getting into blood vessels and lymphatics they are able to make their way throughout the body in the systemic circulation, as they can pass through the lung capillaries. With occasional exceptions, which will be referred to later, only those larvæ which reach striated muscle survive and the most heavily parasitized of these are the muscles that are in more or less constant motion such as the diaphragm, intercostals, muscles of mastication and deglutition, and the pharyngeal muscles, but some also come to rest in the muscles of the limbs.

3. After coming to rest between the muscle fibres the larvæ are at first surrounded by migratory cells and later a thin fibrous capsule is organized. This is oval with its long axis parallel with the muscle fibres. During this period the larvæ grow until they reach 0.8 to 1 mm. in length and 0.03 mm. in diameter. They lie coiled in the cyst and may live for years, the longest period recorded for man being about thirty years and for pigs eleven years according to Faust (1939). Their final fate is death and calcification of the cyst.

### *Course of the disease*

1. *Period of invasion or incubation.*—This is characterized by acute gastro-intestinal disturbance with nausea, vomiting and diarrhoea which may be severe and is in some cases accompanied by hæmorrhage. It is thus clear that this stage must be differentiated from food-poisoning, cholera or dysentery.

2. *Period of migration or the acute stage.*—Myositis is the main feature, and if it is remembered which are the most heavily involved muscles it is clear that there will be dyspnoea, dysphagia and interference with phonation, and there is usually a certain amount of pain in the limbs. A temperature up to 104° or 105°F. is common and in severe infections a 'typhoid state' may develop. At this time mild cases resemble influenza or another of the allied acute fevers, and more severe cases have to be distinguished from the enteric group of fevers. This merges into the third stage.

3. *The critical stage.*—The muscle pain is severe and there is œdema, especially of the face, and a certain amount of general anasarca is usual in bad cases. There are other signs of toxæmia such as cardiac and respiratory complications with cachexia, and in fatal cases the patient sinks into a state closely simulating severe enteric fever.

As a rule the patient slowly recovers because escape of toxins from the larvæ ceases, as they become encysted. The encysted and finally calcified larvæ may cause a certain amount of chronic muscular pain and disability.

The severity of symptoms is directly proportional to the number of larvæ present and it is now known that in most cases they are so few that the disease appears no more serious than a mild influenza or it may be so slight as to pass unnoticed.

*Pathology.*—In addition to the normal encystment in striped muscles and the damage caused by toxins liberated from the larvæ before the capsule is formed, trichinella larvæ may occasionally cause damage to other tissues. Blumer (1936) reported evidence of myocardial damage and lesions in the central nervous system caused directly by trichinella larvæ and a case with myocardial involvement and fatal termination is described by Terry and Work (1940). Evers (1939) reported finding larvæ in the cerebrospinal fluid in twenty-five cases, some of which had definite symptoms of nervous involvement and four of them died.

A great deal of experimental work has been done on trichinelliasis in recent years, particularly in America, and the following facts have been established. Infection of the foetus *in utero* has been proved in guinea-pigs by Roth (1936), animals may be both actively and passively immunized, and Mauss (1940) claims that there is evidence of partial immunity in the offspring of immune animals.

*Diagnosis.*—Diagnosis is difficult and in the initial stage virtually impossible, because there are no characteristic structures in the stools and the antibodies have not yet developed in the blood. Probably the most valuable indication is the information that the patient has had a meal of pork a day or two, previously; this is of special import when the pork has been in the form of uncooked, smoked sausage such as the Germans use so largely.

In the migratory stage, McNaught (1939) says that a common sign is the presence of 'splinter' hæmorrhages under the nails in the distal portion of the nail bed. According to Kerr *et al.* (1941) it is common to mistake trichinelliasis for measles in the invasion stage; this is further evidence of toxic damage to the small blood vessels.

In the second and third weeks antibodies have developed and complement fixation, a precipitin reaction and a dermal reaction may all be demonstrated. The antigen is an extract of dried larvæ recovered from experimental animals and washed completely free of all host substances. Eosinophilia as high as 60 per cent may be found, but eosinophilia is not of much value where high eosinophil counts are very common on account of the prevalence of many other parasites. In the stage of encystment a piece of muscle can be excised and the larvæ found by direct microscopic examination of a 'press preparation', or peptic digestion and extraction of the larvæ by Baermann's technique.

*Prognosis.*—Prognosis in the case of average severity is good, though a certain amount of pain and stiffness may remain permanently. In the early history of the disease, when public health administration was not so effective as it is to-day and meat inspection was not done, epidemics with a high proportion of severe cases were recorded and in some of these the mortality was as high as 30 per cent.

*Treatment.*—There is no specific treatment so that all that can be done is to relieve symptoms as they arise. Calcium and irradiated ergosterol have been used experimentally in rabbits, and Wantland (1934) found that the stage of calcification can be accelerated so that it begins in less than six weeks against seven to eight months in the ordinary way. This is suggested as a possible line of treatment, but a warning is issued against the possibility of causing hypercalcinosis. van Someren (1939) also suggests that gluco-calcium injections may lessen toxicity in the acute migratory stage.

*Epidemiology and prophylaxis.*—Trichinella seems able to invade any carnivorous animal and it is found in pigs, dogs, cats and rats. This shows that complete eradication of the worm from any country where it is endemic would be a very difficult matter. The rat is probably the most important animal in keeping the cycle going. The pig is the only animal of

direct danger to man and when man becomes infected it means the cycle comes to a dead end.

An interesting point in the incidence of trichinelliasis that has emerged recently is that in cities meat inspection is efficient and consequently only lightly infected pigs escape detection and the degree of infection is diluted by the infected meat being mixed with clean meat in making sausages, so the actual number of infected cases is high but none of them are severe and many are not discovered at all clinically. This is shown by McNaught (1939) who estimates that 3 in 100,000 of clinically recognizable cases occur in a community in which 400 in 100,000 will be found *post mortem*. On the other hand, in the country areas where there is no meat inspection and pigs may be killed and distributed privately by a farmer to his neighbours, heavily-infected pork may be eaten in large amount by a few people so there will be a small number of heavy infections.

It is obvious from the above remarks that to prevent human infection all pork must be clean or, if not clean, rendered safe by cooking it long enough to kill the parasites, and the practice of eating pork cured but uncooked or only partially cooked should be discouraged as energetically as possible. In practice, it is not found feasible to prevent lightly-infected pork passing the most careful meat inspection possible, when the economic as well as the public health point of view is considered. Pig food should also be thoroughly cooked because pork condemned for human consumption on account of containing trichinella might easily be given raw to pigs as a means of economy, but clearly a false economy.

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## THE TREATMENT OF WAR INJURIES OF THE EYE

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WITHIN the last two years much has been written in the journals on the treatment of war injuries of the eye, and a résumé may not be out of place as the war has now approached the gates of India and air raids may occur at any time in our towns.

From the experience of extensive heavy air attacks over Britain, war injuries of the eye have not been found to be very different from those in civil life, where industrial injuries are caused by glass, metal or other foreign bodies, and the treatment is very much on the same lines. There have been, however, a large proportion of serious bilateral injuries.

### War injuries to the eye

These are classified according to Tyrrell—

#### I. Non-penetrating—

- (a) Dust and debris in the conjunctival sac.
- (b) Glass in the conjunctival sac.
- (c) Concussion injuries of the globe.

#### II. Penetrating but not perforating—

- (a) Wounds of the eyelids.
- (b) Corneal foreign bodies.
- (c) Burns of the eyelids, conjunctiva and cornea.
- (d) Glass in the cornea.
- (e) Glass in the sclera.
- (f) Subconjunctival metal or dust or other foreign matter.

#### III. Perforating injuries—

- (a) Metal.
- (b) Glass.
- (c) Other matter—
  - (1) Of cornea, uncomplicated.
  - (2) Of cornea, complicated.
  - (3) Of corneo-scleral junction.
  - (4) Of sclera.

Most ophthalmologists who have had experience of bombing raids are of the opinion that in eye injuries early operative interference is not quite such a necessity as we have always been taught. Cases that had to be left twenty-four hours before operation did quite well, despite the danger of infection.

### I. Non-penetrating injuries

In the non-penetrating injuries the conjunctival sacs are usually filled with a mixture of mucus and dirt, and it is wise to treat these eyes to two-hourly irrigations with an alkaline lotion (2 per cent) before attempting any operative interference, and preliminary to operation to irrigate with a 1 : 1,000 silver nitrate solution. All glass should be removed from the conjunctival sac, and it will usually have to be picked

out under local cocaine anaesthesia as it is the most tenacious of all the conjunctival foreign bodies. Concussion or blast injuries of the eye are divided into : (a) Hyphæmia, (b) rupture of the iris, (c) rupture of the lens capsule, (d) subluxation of the lens, (e) vitreous hæmorrhage, (f) dilated retina, and (g) commotio retinæ.

Large numbers of these cases have been seen and the orthodox treatments are well known. Traumatic detachment of the retina, whether due to concussion or a direct blow, is rare.

## II. Penetrating but not perforating injuries

Wounds of the eyelids are common and the most difficult to treat. They nearly all go septic unless the edges of the wounds are excised, which is often impossible when there is much damage to the tissues. The wounds should be cleansed with warm saline, hydrogen peroxide, etc., and all obviously damaged tissues, unlikely to survive, should be excised. If possible, the edges of the wound should be sewn up but if sepsis is likely to result the wound should be left open. When there are multiple foreign bodies on the cornea they are best left alone. The pupils should be kept well dilated with oily atropine (1 per cent) and later with liquid paraffin or boro-vaseline. The foreign bodies rapidly fall out and any that do not can be taken off later.

**Burns.**—Most ophthalmologists agree on the danger of using tannic acid for skin burns of the face. The triple dyes give good results. Burns of the cornea are very uncommon owing to the film of tears over it. A simple and effective method is to cover the burns with *tulle gras* impregnated with vaseline and balsam of Peru (2 per cent). The *tulle gras* dressing is covered with six or eight layers of gauze wrung out in warm normal saline. Care should be taken that the dressing is kept moist by adding more saline from time to time. The gauze dressing if possible should be changed every four hours for the first few days but the *tulle gras* dressing is left in place. The latter is changed twice a day at first and later once daily.

Skin grafting should be carried out as early as possible.

**Note.**—*Tulle gras* is prepared in the following way:—Mosquito curtain net (2 mm. mesh) is cut into pieces of 9 cm. square. These are put in a metal box slightly larger in size and impregnated with the following mixture:—

|                   |          |
|-------------------|----------|
| Soft paraffin ..  | 96 grms. |
| Balsam of Peru .. | 2 grms.  |

This is sterilized over a water-bath.

Glass in the cornea and sclera are dealt with in much the same way as foreign bodies on the cornea. Subconjunctival foreign matter may require excision of the part of the conjunctiva affected.

## III. Perforating injuries

Glass is by far the most important cause in these injuries. It is very difficult to see, even

with the corneal microscope, and difficult to extract. Fortunately in most cases the glass works its way out even from the depths of the wound. Unless the eyeball is too pulped to save there is no harm in waiting to see if the eye can be saved from removal, especially if both eyes have been seriously injured. Often patience has been amply rewarded and useful vision has resulted.

There is so far no proof, if both eyes are injured, that sympathetic ophthalmia may occur. It is often better to wait and no harm will result in delaying the removal of a protruding foreign body in the eyeball, as a fibrinous exudate will form around the piece of metal or glass and may prevent vitreous from escaping. As the injury to the eye is nearly always with other injuries of the face and body the delay will allow him to get over the state of primary shock. Glass in the vitreous is best left alone, and an eyeball should not necessarily be removed because glass is there but as a rule intra-ocular glass cases have the eye disorganized. Window glass is relatively opaque to x-rays, and a useful way for approximate localization is to x-ray the eye from front and side after fitting a Zeiss contact glass with a dot of sealing wax on it, to mark the centre of the cornea of the patient. The relative position of the shadows gives a good idea of the position of the foreign body. Another method of localization is to inject an opaque substance such as lipiodol under the conjunctiva as close as possible to the cornea, and to take an x-ray photograph. This will show up the curvature of the globe of the eye, and the rest of the curve could be reconstructed geometrically so as to show whether the foreign body is inside or outside the eye.

Sulphanilamide as a local measure has not generally proved to be of much value as a preventive of sepsis or as a treatment of sepsis once established, although individual doctors have spoken of its efficacy locally in a 30 per cent solution in infected wounds of the eyelids and punctured wounds of the cornea.

If possible removal of foreign bodies on the eyeball are best done under local anaesthesia, as one gets the co-operation of the patient, but if the patient is sensitive and apprehensive general anaesthesia should be employed, preferably by the intravenous route, with sodium pentothal or evipan. There is, however, sometimes difficulty in controlling the eye when this method is used. Shock is not a contra-indication to the administration of these drugs, rather the reverse, provided they are properly administered. Gas and oxygen or cyclopropane can also be used, but ether should be avoided and chloroform never used. Spicules of glass in the anterior chamber should be removed through a keratome section at the appropriate position, followed by lavage of the anterior chamber with normal saline.

# THE PREPARATION OF LIQUID SERUM FOR TRANSFUSION PURPOSES

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The clinical value of serum or plasma is now so well established, that no well-equipped institution can afford to be without a store of the fluid. Although citrated whole blood is necessary in a 'bank', a proportion of one citrated blood to 10 of liquid serum or plasma is a good practical arrangement. Plasma from 14-day-old citrated blood can be pooled and filtered for later use, but its processing is more tedious than that of serum. It is therefore advisable to keep for 30 days or less if haemolysis occurs a sufficient amount of citrated blood for emergency purposes, and then discard it. All other blood withdrawn is used for processing as serum.

Processing serum presents no difficulties provided the closed-circuit method is used. In the method used by us during the last 2 years, there is no exposure to air except that filtered through a large well-packed cotton-wool filter from the time the needle enters the vein of the donor to the final packing of the liquid serum. The method is particularly suited to India where the air is heavily laden with dust. Beyond turning off the fans during the separation and pooling process, and when assembling the clarifying and filtering apparatus, no special precautions are taken, and no attempt is made to sterilize the air in the working room. We use a technique that can be described as a combination of surgery and bacteriology.

All apparatus, with the exception of Seltz filter pads, has been made locally.

Utilizing the existing medical staff, we have regularly bled 20 to 25 donors per week for 2 years, producing 6 to 8 pints of serum. Separation and pooling occupy a session of about 1 hour weekly. Clarification and filtration, a session of 1 to 2 hours weekly. The above amounts could be increased, if desired, to 40 donors weekly, and filtering 20 pints of serum without imposing an undue strain on the staff or needing additional assistance.

An institution should therefore have no difficulty in adequately providing for its own needs, and with very little extra assistance could increase its filtering capacity to 50 pints per week, as the process is practically automatic.

## Blood-withdrawing for serum preparation

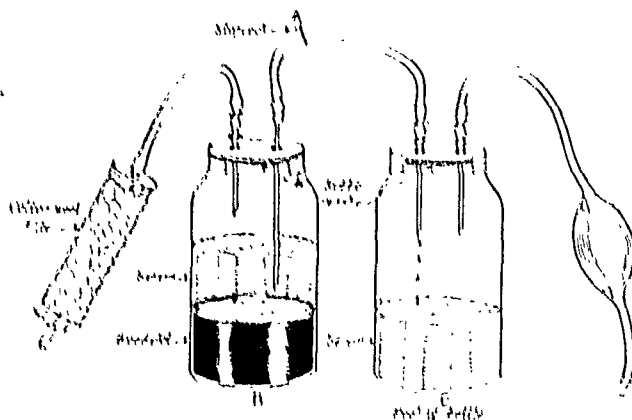
The method of blood-withdrawing has been previously described (Hayes and others, 1941). Horlick's bottles are used. The caps are flamed, perforated by 2 holes of  $\frac{1}{2}$ -inch diameter, and fitted with rubber washers made from a motor lorry inner tyre. (All cap washers are so made.)

Bottles are specially cleaned before being taken into use (see appendix). The capacity is 10 ounces, which we consider a suitable amount to withdraw from the average donor. Blood for Wassermann reaction is taken from the withdrawing tube. After the bottle is filled the cap holes and edges are sealed with paraffin wax and the bottle stored at 2° to 6°C. for as long as 5 days.

## Separation and pooling

The apparatus is shown in figure 1. Vacuum is obtained by means of a reversed Hugginson's syringe, or a water vacuum pump. For separation of a large number of bottles, two sets of apparatus are used connected by a Y-piece to a large winchester which is connected to the vacuum. The Horlick's bottle (C) shown in figure 1 is replaced by a whisky bottle fitted with a rubber bung in which a short inlet and a long exit tube are fixed. The long glass tube is connected to the Y-piece of the pooling bottle. Each operator therefore has his own bottle in which he can observe the rate of flow of serum.

Fig. 1.



and adjust it with the glass stopcock (A) attached to the rubber tubing. The top of the Horlick's bottle is thoroughly flamed, and the 9-inch steel needle plunged sharply through the rubber washers; the stopcock is then fully opened and  $\frac{2}{3}$ rd of the serum aspirated; moving the needle as required to avoid the clot, the stopcock is then closed to slow down the flow to a rapid drop, and finally to a slow drop. When as much serum as possible has been aspirated the stopcock is closed and the process repeated with another bottle.

Used needles are syringed through with cold distilled water and then boiled in distilled water.

The average time taken to separate one bottle is 6 minutes.

The pooled serum bottle is closed with a rubber cork under a flame, the neck is covered with cellophane or lint, and the bottle stored at 2° to 6°C. for as long as 5 days.

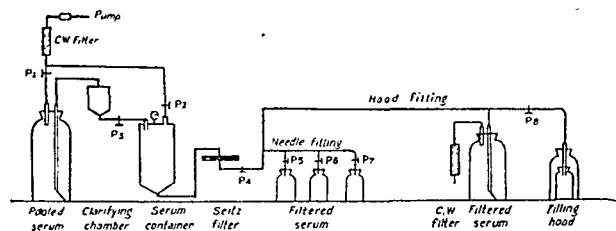
## Clarification

Pooled serum is turbid, due to deposition of fat. Red cells are also present. Filtration or



clarification is necessary, otherwise the Seitz filter-pad will clog. We clarify and filter at the same time. The combination of apparatus is shown in figure 2. Positive pressure, provided by a foot pump, is used throughout and usually 2 pounds per square inch is sufficient. A motor tyre valve is connected to the pressure tubing leading to the cotton wool air filter.

Fig. 2.



Double lines = Glass tubing.  
Single lines = Rubber tubing.

In clarifying, pooled serum is forced through the clarifying chamber containing a pad (see appendix) into the serum container. It is then 'gin' clear. Pinchcocks P1 and P8 are opened and all others closed. To allow air to escape, the tubing and P2 are removed from the serum container, the end of the tube being wrapped in a sterile cloth. After clarification, the tube is replaced, pressure is applied by means of the pump and the pooled serum forced through the clarifying pad into the serum container, after which P1 and P3 are closed, P2 opened and filtration commenced.

#### Filtration

Consists of forcing the serum through a bacterial pad. The filter used is a 14 cm. Seitz. The pads are either Seitz E/K. or Ford S.B. pads.

With the above, 2 litres can be filtered in approximately 1 hour, and 3 litres can be filtered through one pad, provided the closed circuit method is used.

All pinchcocks between the filter and bottles to be filled must be open. At first, pressure is applied slowly—4 to 5 strokes of the pump will suffice followed by an interval of 2 to 3 minutes, in order that the filter pad may become thoroughly wet. The pressure is then gradually raised to 2 pounds and maintained.

#### Filling

Two methods are described :

A. *Needle method.*—Three bottles (gin or whisky) can be used for one filter. Two glass T's are inserted into the tubing—to the free ends and also to the end of the tubing—adaptors and pinchcocks (P5, 6 & 7) are fitted.

Bottles fitted with screw caps pierced by one  $\frac{1}{4}$ -inch hole and rubber washers are sterilized in the high-pressure sterilizer with their caps loose. The cap is flamed, and an intravenous needle is plunged through the central hole in the cap and fitted to the adaptor on the T-piece. Samples

for sterility tests can be taken in a similar manner (2 c.cm. of serum to 20 c.cm. sloppy agar).

B. *Hood method.*—The serum passes directly from the filter into a large bottle (filtered serum). When full, P4 is closed. A bottle is placed under the filling hood, P8 is opened and pressure applied to the air filter. A pint bottle is filled in one minute. It is then removed and capped under the flame. This method is useful when automatic working is required as several bottles can be connected in series, or very large bottles used. Until the bottles are filled the only attention required is that of maintaining 2 pounds of pressure in the serum chamber.

After filling, the caps of the bottles are screwed tight and paraffin wax applied to the central hole and edges. The cap and neck are covered with cellophane.

#### APPENDIX

##### *Cleanliness of apparatus*

It is essential that the inside of all apparatus should be thoroughly clean. Efforts should be concentrated on the *inside* and not the outside of all tubes. Rubber tubing should be of short lengths, to facilitate cleaning. This applies to all tubings, whether glass, rubber, or the narrow lumen of needles. After use, tubings should be cleaned under pressure with cold water. The final washing, prior to sterilization, should always be in distilled water. *Too much time cannot be spent on cleaning the inside of tubing used for intravenous work.*

##### *Preparation of rubber*

New rubber must be boiled for 30 minutes in alkali (0.1 per cent NaOH or washing soda 2 teaspoonfuls to half a pint of water). It is then rinsed thoroughly in tap water, followed by distilled water. At fairly frequent intervals rubber should be re-treated.

##### *Preparation of bottles and glassware*

Bottles and glassware should be first boiled in soapy water for 15 minutes, washed in tap water and immersed in the following mixture for 24 hours : Potassium dichromate (commercial) 100 gm., sulphuric acid (commercial) 250 c.cm., water 750 cm. Following this they should be thoroughly rinsed in tap water until water is neutral to litmus, and finally in distilled water.

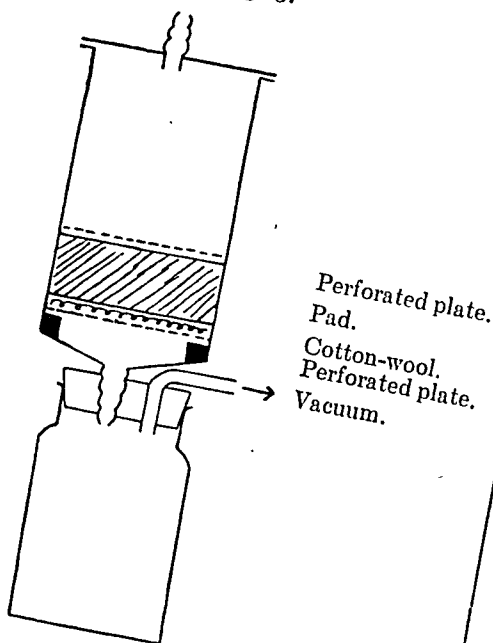
##### *Preparation of clarifying pad*

Perfecta pulp is the best material to use, if available. It is broken into pieces, immersed in distilled water for 12 hours and then autoclaved.

Equal parts of half-beaten paper pulp and white blotting paper make an efficient substitute. They are soaked in tap water for 24 hours in a large bowl. The mixture is then thoroughly beaten with a large fork or egg beater, and the water removed by passing through a very fine sieve. This is repeated until

the mixture is white—when distilled water is used, for about 5 changes. It is then placed in Horlick's bottles, capped and autoclaved twice. The component parts of the clarifying chamber are shown in figure 3. The perforated plate and layer of cotton wool are inserted into the

Fig. 3.



Preparation of clarifying pad.

chamber prior to sterilization. Before the assembly of the completed apparatus (figure 2), the clarifying chamber is fitted into the bottle, and the pulp poured in and rammed with a rammer made of a rubber cork on a glass rod, starting at the centre. During this operation a vacuum is created which extracts the remaining water. Failing this, the lid of the chamber may be applied and positive pressure applied. The ramming must be thorough, and as much water as possible removed. The upper perforated plate is then applied and the lid screwed down. A pad 4 inches  $\times$   $\frac{1}{2}$  inch will clarify 2 litres of serum.

#### Sterilization of bottles and other apparatus

Bottles, after thorough cleansing and rinsing in distilled water, are sterilized at 20 pounds pressure for one hour. Before sterilizing, the caps are screwed down tightly and loosened half a turn. If a vacuum is required, as in blood-withdrawing bottles, the caps are again tightened following sterilization and when the bottles are hot.

Sietz filters containing the pads are sterilized as above. The serum container and clarifying chamber can be sterilized in the sterilizer or by attaching a steam pipe, and raising the pressure to 5 pounds for one hour. Glass and rubber tubing are best sterilized by boiling in distilled water for half an hour.

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#### A NEW TYPE OF DRIP REGULATOR FOR INTRAVENOUS TRANSFUSION WORK

By S. N. HAYES, F.R.C.S., F.R.C.O.G.  
LIEUTENANT-COLONEL, I.M.S.

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The ordinary all-glass regulator is fragile and difficult to clean—and nowadays to obtain. The type described below (figures 1 and 2) is

Fig. 1.

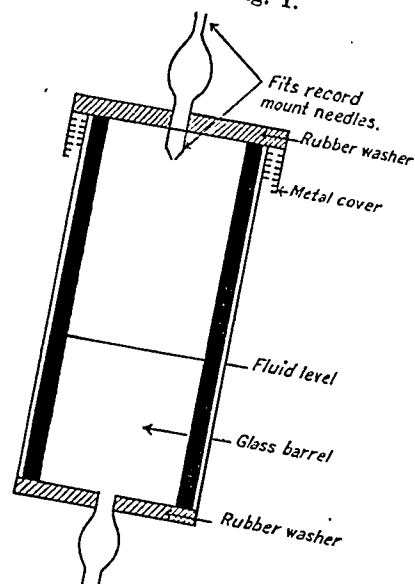
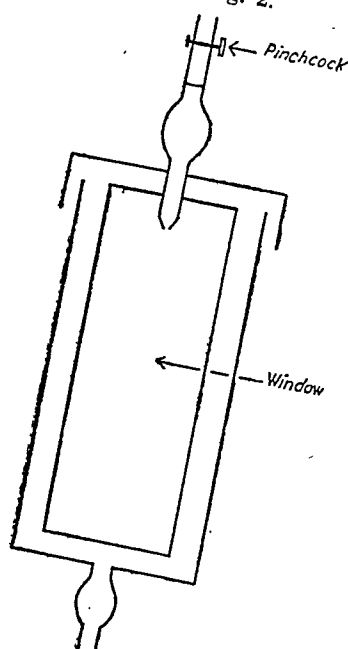


Fig. 2.



an attempt to provide a drip regulator as near as possible indestructible, with an adaptor to fit  
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#### REFERENCE

HAYES, S. N., DEALL, S. R., SAMI, M. A., BAMFORD, P., and RAO, V. K. (1941). *Indian Med. Gaz.*, 76, 649.

## WEIL'S DISEASE WITH SPECIAL REFERENCE TO ITS DIAGNOSIS AND TREATMENT\*

By H. A. H. D'SILVA, M.R.C.S. (Eng.), L.R.C.P. (Lond.),  
D.T.M. (Cal.)

Mount Abu

THIS note is based on the final results of observations and treatment of 60 consecutive controlled cases treated during the height of a Weil's disease epidemic (September and October

\* Redrafted and abridged by Editor in consultation with Professor B. M. Das Gupta.

(Continued from previous page)

two record mount needles—used for the transference of distilled water into dried plasma bottles that are *in vacuo* (American type). It can also be used as a bead or wool filter.

The construction is simple; consisting of an outer case made out of thin brass tubing. Two windows are cut out in order that the dropper and fluid can be seen. Inside the casing is a piece of glass tubing which fits loosely. The tubing rests below on a perforated rubber washer. Inside the cap is a second washer. When the cap is screwed on to the casing the glass barrel is firmly held by the two rubber washers.

The cap is strongly made and the upper rubber tube attachment and dropper are made to fit record mount needles, thus providing a two-needle mount for use with American type dried serum which is packed *in vacuo*.

One needle is thrust through the rubber cork of the distilled-water bottle, which is then inverted, and the other needle is thrust through the cork of the dried serum bottle. Distilled water then flows into the dried plasma bottle.

The flow is controlled by a pinchcock placed above the regulator. All air is firstly expelled from the apparatus by raising the needle level with the transfusion bottle. The needle is raised and lowered until all air is expelled. The pinchcock is then closed and the level of the fluid regulated by unscrewing the cap and allowing air to enter. When the required level is reached the cap is tightened. The pinchcock is then opened to regulate the rate of flow. At one drop per second, one pint of fluid flows in three hours. Then after use unscrew the cap, take to pieces and place in cold water, remove washers and wash thoroughly in cold water. Rinse in distilled water—dry and reassemble. Sterilization can be effected by boiling or autoclaving (20 minutes at 15 pounds).

### Replacements

Rubber washers can be made out of rubber corks, old motor tyres, etc.

Glass barrels can be made of glass tubing of suitable size. After cutting, the ends can be smoothed by rubbing on a smooth whetstone.

The regulator was made for me by The Pearl Surgical Works, Lahore.

1938), out of 250 cases treated by me from October 1937 to January 1939 in the Andaman Islands.

Weil's disease appears to include a variety of conditions in which fever, severe prostration, albuminuria and possibly jaundice are prominent symptoms; but many cases of true Weil's disease have escaped diagnosis, because the existence of a non-icteric type was not recognized until recent years, and laboratory diagnosis was not available.

At times even those long familiar with the disease are not able to diagnose it on clinical grounds alone owing to its protean nature. In sporadic cases Weil's disease is often not thought of until jaundice appears on the fifth to seventh day.

Serological diagnosis as discussed by Walch-Sorgdrager (1939) and by Das Gupta (1938) is of great help in diagnosis, but usually not before the tenth day of the disease. Various serological types of leptospira should be available for agglutination tests, or some genuine cases may remain undetected for want of inclusion of the homologous strain in the test. Early diagnosis is naturally a great advantage from the point of view of treatment and of limiting the spread in mines, labour camps, trenches, etc., and of lowering the mortality rate.

### Clinical diagnosis

In endemic areas, with some experience of the disease, it is not difficult to detect a case. In unsuspected areas which are by no means uncommon, it is desirable that the following signs and symptoms should be borne in mind:—

**Prostration.**—This is out of all proportion to the fever, which ranges between 100°F. to 102°F. in 95 per cent of cases.

**Pains in the body.**—Acute and even excruciating pains confined to the muscles of the lower limbs, neck and to a lesser extent of the arms and the body are present at the very onset. Pain over the epigastrium, the precordial regions, the liver, and the gall-bladder is often present as an early symptom.

**Conjunctival injection.**—Injection of the conjunctivæ without photophobia is one of the earliest signs and is often associated with patchy hæmorrhages. The presence of this latter manifestation presages a severe attack. There is usually no associated coryza or subsequent conjunctivitis.

**Fever.**—The onset is sudden and is accompanied by marked prostration. The temperature usually varies from 100°F. to 102°F. In the majority of cases it comes down by lysis to normal within 3 or 4 days, although occasionally it may persist for a week or 10 days. Hyperpyrexia (except after intravenous saline) has been noticed in a few cases only. In 30 per cent of cases there has been a small secondary rise after the initial temperature has been normal

for a week or so. This recrudescence is probably due to some complications, *e.g.*, bronchitis, nephritis, cystitis, to food taken surreptitiously or to leaving the bed too soon. I have found bacilluria and cystitis to be the cause of secondary fever in 5 per cent of my cases.\*

*Jaundice* was present in about half of the cases under discussion. It may appear as early as the third day or may be delayed till the sixth day of the disease. Early appearance of jaundice associated with some of the other signs and symptoms, or with albuminuria alone should leave no doubt as to the diagnosis, especially in areas where yellow fever does not exist. But its absence or delayed appearance should not mislead anyone who has seen non-icteric cases of the disease. The degree of jaundice is proportionate to the severity of the case. Itchiness of the skin is conspicuous by its absence.

*Renal symptoms.*—In 95 per cent of cases albumin appeared on the second or third day and varied from a trace to a large amount. Albuminuria is said to be transient, by many workers, but in my series of cases it persisted for 2 to 7 weeks. A sudden and early albuminuria in an apparently healthy person, in an endemic area, is most significant. In fact, it is the most constant sign, and perhaps the only sign in some cases, when the symptoms are very mild. At the early stage of the disease the sediment shows no casts, but these may appear later, together with red blood corpuscles, pus cells and cylindroids.

In jaundiced cases bile was present in varying quantities. As a rule it is absent in non-icteric cases, although in a few it was demonstrable.

Retention of urine and anuria occurred in some cases. The latter is an indication of a very grave condition, and unless energetically treated almost invariably leads to a fatal issue. These complications occur late in the course of the disease.

*Respiration and pulse.*—Respiration is usually shallow and slow except in cases with early congestion of the lungs.

In an average case, the pulse rate at the onset is rarely over 100 per minute even with a temperature of 102°F. At the end of the third or fourth day, it drops even below normal rate though the temperature may vary from 100°F. to 102°F.

A pulse rate of 100 per minute or over, especially when associated with jaundice, is an unfavourable sign. Failure of the pulse rate to fall with the course of the disease points to cardiac and respiratory involvement. A soft and rapid pulse is found in 30 per cent of cases. In those cases where prostration and muscular pains are very severe, where hæmorrhages have supervened, and in highly jaundiced patients, the heart beat is feeble, or scarcely audible. This appears to indicate that the cardiac muscle shares early in the general myasthenia. This is confirmed at *post mortem*, when the heart is

found to be pale—if not yellow—and flabby, with pericardial fluid in excess.

*Cardiac embarrassment or a burning sensation in the chest.*—This is often complained of at the early stage and is one of the most distressing features of the disease. It makes prognosis very grave, especially in nervous and restless cases.

The *tongue* is typical of any acute specific fever such as typhus, plague and smallpox. In mild cases, it is only slightly coated and fairly moist, especially if the diet includes plenty of fluids, glucose and fruit juice. But in severe cases with marked toxæmia, it is dry and red at the margins and later becomes coated and is protruded with difficulty (parrot-tongue).

*Liver, spleen and gall-bladder.*—Whether associated with jaundice or not, slight enlargement of the liver, especially its left lobe and gall-bladder, occurs in 50 per cent of cases. It is remarkable, however, that the spleen is rarely enlarged or tender.

*Hæmorrhage.*—This may occur early or late, may be slight or severe and usually starts on or about the fourth day of the disease, as epistaxis, hæmoptysis and less commonly as melæna, hæmatemesis and extensive petechial hæmorrhages. Hæmaturia and hæmorrhagic stools are rare symptoms, occurring on 25 per cent of cases seen. These symptoms were absent in the cases in which urotropin was given.

*Later symptoms.*—It is remarkable that during the early stages of the disease in most cases there were no signs of gastro-intestinal irritation, as seen in cases of other specific infectious diseases. But later, when the fever is high and jaundice and toxæmia are intense, one finds nausea, vomiting, hæmatemesis, hiccough, melæna and abdominal distension of varying degrees. Of these, persistent or recurring hiccough, and vomiting\* with meningism possibly of cholæmic origin, are probably the most troublesome and worst symptoms from the point of view of treatment and prognosis.

#### Laboratory diagnosis

*Blood picture.*—During the first 3 or 4 days of the illness as in some other infectious fevers there is a leucocytosis, the numbers varying from 10,000 to 15,000 per c.mm. with an increase in the percentage of polymorphonuclear leucocytes (70 to 85 per cent).

*Blood cultures* made in suitable media during the first week of the disease are usually positive. Positive cultures are rarely obtained after the seventh day.

#### Animal inoculation

Guinea-pigs were inoculated intraperitoneally with blood obtained during the first week of

\* Persistent hiccough and vomiting are usually associated with peritonitis, but cases with these symptoms which ended fatally did not reveal the signs of peritonitis on autopsy in my series of cases, so that one concludes that these symptoms are of toxic origin.

illness. In the inoculated animals jaundice was either absent or appeared later, and leptospira could not be demonstrated before the seventh day after inoculation.

*Urine examination.*—In a large percentage of cases the spirochæte can be demonstrated in the urinary deposits after efficient centrifugalization. I found cultures gave good results, but staining of the deposit by Fontana's method proved unsatisfactory.

*Serological tests* have already been referred to.

*Differential diagnosis.*—Negative findings are of considerable importance in arriving at a diagnosis, especially in areas where malaria, typhus, dengue and sand-fly fever are prevalent. The district where these observations were made luckily enjoys freedom from most of the above diseases and the diagnosis was, therefore, easy. The absence, in an average case, of headache, rigors, early rash, photophobia, coryza, early nausea, rapid pulse, or respiration is distinctly helpful.

*Post-mortem findings.*—These vary according to the duration of the disease and the cause of death. Post-mortem examination has been done on 20 cases since 1937. Practically all of them came under observation very late, with severe cholæmia and died either from hæmorrhages, lung congestion, anuria or sudden cardiac or respiratory failure. On opening the body the tissues were found to be intensely jaundiced. The serous fluid in the abdomen, thorax and pericardium has increased in amount and was bile-stained. In some cases where jaundice was slight during life it was conspicuous and definitely demonstrable *post mortem*.

*Liver*—enlarged, usually dark-red in colour and sometimes with brown or grey necrotic areas.

*Spleen*—congested.

*Kidneys*—generally enlarged, red or pale-yellow with occasional brown or grey necrotic areas.

*Suprarenals*—congested.

*Bladder*—empty in most cases.

One or two patients that died early showed congestion of the stomach and intestines.

It was possible to perform autopsy in many cases within a few minutes of death. It is extremely difficult to demonstrate leptospira in organs if they are examined after 6 to 12 hours, even in typical fulminant cases. Yet the examination conducted within half an hour of death easily revealed the spirochæte, which showed a great predilection for the heart muscle. In two nephritic or cardiac cases without jaundice the kidneys showed hardly any leptospiræ, whereas the cardiac muscle revealed a very large number. Outside an epidemic area such cases might be easily mistaken for acute congestive cardiac or renal failure.

#### *Cause of death*

- (a) Cardiac and respiratory failure,
- (b) anuria and uræmia,

(c) hæmorrhages from lungs, stomach or intestines,

(d) cholæmia,

(e) pneumonia.

#### *Some atypical forms of the disease*

I. Malaria-like onset. Fever lasting for 24 to 48 hours only. Late albuminuria; hæmorrhages during afebrile period.

II. Complete absence of pains. Slight fever with prostration, albuminuria and jaundice. Very few cases of this type seen.

III. The pneumonic or influenzal type with massive consolidation of one or both lungs. This type is fairly common.

IV. The 'melæna' type with fever and profuse hæmorrhage.

V. The cerebral or meningeal type with early unconsciousness, delirium, etc.

VI. The cardiac or nephritic type simulating acute congestive cardiac failure. This constitutes a large percentage.

VII. Intensely jaundiced type without 'black vomit'.

VIII. The 'yellow fever' type with 'black vomit'.

IX. The non-icteric type. The cases are generally mild. About 50 per cent of my cases belong to this group.

X. A chronic meningeal and a chronic icteric form were encountered, and these two types comprised 10 per cent of cases.

#### *Treatment*

The treatment of this serious disease is very cursorily dealt with in most textbooks of medicine and monographs dealing with the subject. A full description of the treatment adopted by me is given below; it is mainly symptomatic yet is sufficiently specialized to be dealt with *in extenso*.

*Rationale of treatment.*—After treating a large number of cases of Weil's disease my conclusion is that the broad principles should be (a) ensuring rest, (b) quickly eliminating the toxins, and (c) 'anticipatory therapy', i.e., preventing the onset of the grave symptoms and sequelæ, such as hæmorrhages, cardiac failure, toxæmia, cholæmia, anuria, persistent hiccough and vomiting, hyperpyrexia, parotitis and cystitis.

(a) *Rest.*—Absolute rest in bed is essential in view of the possibility of sudden heart failure due to cardiac musculature being involved during the acute and convalescent stages. Early administration of sedatives was found necessary owing to the intensity of muscular pains and restlessness. In most cases tincture hyoscyamus in 5ss to 5i doses and A.P.C. powders were sufficient to relieve pain, but in some severe cases where restlessness was due to cardiac pains and meningism, veronal grs. x to xv in 6 ounces of warm milk morning and evening was found to be most beneficial. Paraldehyde is also probably useful.

(b) *Elimination of toxins by—(i) diuretics and diaphoretics.*—If the patient was seen on the third or fourth day of the disease the following mixture was given for 2 or 3 days :—

|                          |              |
|--------------------------|--------------|
| ℞                        |              |
| Potassii citratis        | .. grs. xx   |
| Spiritus ætheris nitrosi | .. ℥ xx      |
| Tincturæ hyoscyami       | .. ʒss to ʒi |
| Calcei lactatis          | .. grs. x    |
| Aquam camphoris          | .. ad ʒi     |

*Fiat misturam.* t.d.s.

But if the patient came under observation after the fourth day or was in a very toxic condition from the very onset, the following mixture proved efficacious :—

|              |                 |
|--------------|-----------------|
| ℞            |                 |
| Urotropinæ   | .. grs. x or xv |
| Glucose      | .. ʒi           |
| Aquam anethi | .. ʒi           |

*Fiat misturam.* t.d.s.

preceded every half hour by another mixture, viz :—

|                          |            |
|--------------------------|------------|
| ℞                        |            |
| Acidi sodii phosphatis   | .. grs. xv |
| Spiritus ætheris nitrosi | .. ℥ xx    |
| Tincturæ hyoscyami       | .. ʒi      |
| Aquam camphoris          | .. ad ʒi   |

*Fiat misturam.* t.d.s.

Here urotropine acts primarily as a biliary and urinary antiseptic, and secondarily perhaps as a spirochæticide against the leptospiræ, which are believed to lodge inside such organs as the liver, gall-bladder and kidneys, when the organisms disappear from the peripheral blood after the fourth or fifth day of the disease. The mixtures should be discontinued after 8 or 10 days, or earlier if hæmaturia supervenes. In my series of cases, except for a boy of seven, there was not a single case that developed hæmaturia or hæmoglobinuria, though copious quantities of albumin were detected daily in many cases. Moreover, urotropin, being excreted by the meninges, proved a valuable remedy in the meningeal type of the disease. It also prevented subsequent bacilluria and parotitis. 'Catagone' by intravenous injection was tried with great success in 10 cases in place of urotropin.

(ii) *Purgative.*—On admission, a single dose of magnesium sulphate or sodium sulphate—ʒi, was given and continued in ʒi doses every morning for 3 or 4 days preceded by either blue pill—grs. ii or pil. colocynth. co. grs. ii at bedtime, with the object of ensuring at least two motions a day. More frequent motions are to be avoided and the dosage of the salt and the pills have to be regulated accordingly.

(c) *Anticipatory therapy. (i) Hæmorrhages.*—As soon as a clinical diagnosis of Weil's was made hæmostatic serum 5 c.cm. was given intramuscularly, and usually hæmorrhages were rare after

its administration. If hæmorrhages did occur later, they were not severe and a further dose of 5 c.cm. of the serum was sufficient to check them. If serum is not available calcium chloride grs. xv t.d.s. may be given orally.

(ii) *Cardiac failure.*—At the least sign of any cardiac pain or embarrassment and/or when epigastric pain was marked, a mustard plaster obliquely over the epigastrium to cover the heart, left lobe of the liver and gall-bladder was applied for half an hour or so, and subsequently glycerine was applied on the area. In the case of threatening cardiac failure, intravenous saline in small doses (with 5 per cent glucose) was tried in several cases with good results. A glucose-brandy mixture with tinct. nucis. vom. ℥ x was given to cases with soft feeble pulse, coramine, camphor in oil, adrenalin, strychnine, digitalis, etc., were given subcutaneously, s.o.s. in moderately severe cases.

*Toxæmia, cholæmia, and anuria.*—My previous practice of administering normal saline 12 to 15 ounces with 5 per cent glucose intravenously was soon discontinued except in very severe toxæmic cases or in those that refused food. Subcutaneous saline\* was tried in some cases but under epidemic conditions 'in the field', this procedure is probably unsafe and it was given up in favour of warm high rectal saline 12 to 20 ounces, with or without 5 per cent glucose, two or three times a day till the eighth day or longer according to the severity of the case.

*Hiccough and vomiting.*—If persistent, these symptoms signify a grave prognosis due to subsequent dehydration and cardiac embarrassment. Therefore early administration of intravenous† and rectal salines as well as sedatives, as stated before, was employed in these cases. In addition to the above measures hydrogen peroxide solution (10 volumes)—ʒi in an ounce of cold water, tinct. iodi.—℥iii in water every 15 minutes, mustard plaster, etc., were effective in some cases.

*Hyperpyrexia.*—In the earlier series of cases where hyoscyamus and veronal had not been given, some deaths resulted from hyperpyrexia and convulsions.

*Cystitis and parotitis.*—As already stated, early administration of urotropin completely controlled these complications in my later series of cases.

*Specific treatment.*—Though tried only in 10 cases my experience with anti-leptospira serum  
(Concluded on next page)

\*In some 3 or 4 of the early cases hæmatoma developed at the site of the injection and later suppurated. This was thought to be due to some extraneous infection. But as suppuration also set in in a few later cases when the same saline, with the same aseptic care, did not produce suppuration in other cases, it may be concluded that autogenous infection must have been the cause.

† Sometimes adrenalin solution ℥iii was added to each 10 ounces of saline for intravenous injection.



## TRANS-GRAFTING OPERATION FOR TRICHIASIS AND ENTROPION OF THE UPPER LID

By H. A. H. PATHAN, L.C.P.S., S.S.M.S.

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AMONGST various complications of trachoma, trichiasis and entropion are the most common complications requiring surgical intervention. Different operations have been devised by various surgeons but a few only have been practised, e.g., the commonest being (i) electrical epilation, (ii) Jaesche-Arlt's operation, (iii) Snellen-Streatfield's operation, and (iv) grafting of mucous membrane from the lip in the inter-marginal space.

All these operations are a matter of individual choice and have only a limited usefulness, as, where one operation is useful in one case, the same may not be applicable in another, and when applied to the worst cases the results are often unsatisfactory.

The modern operation of grafting of mucous membrane from the lip in the intermarginal space, though apparently it looks to be a very sound and logical one, has in practice been found difficult and its results are not what have been hoped for. The sepsis of the mouth and the subsequent sepsis in the wound grafted and the

(Continued from previous page)

in doses of 40 to 60 c.cm. intravenously was very disappointing. The failures might have been due to the difficulty in obtaining a polyvalent and potent anti-serum against the different local strains of leptospira\*. Moreover, the serum is expensive and said to be effective only in the earlier stages of the disease.

### Summary and conclusions

1. Weil's disease is a specific infective disease and is more widely distributed than is generally believed. It may make its appearance in severe epidemic form under certain weather conditions and, as in the last war, under certain camp conditions which appear to favour outbreaks.

2. The possibility of Weil's disease should be remembered in dealing with any case of obscure acute jaundice, early or late.

3. Diagnosis of Weil's disease is not a difficult matter in a clinical side room equipped with dark-ground outfit.

4. Early diagnosis of Weil's disease is essential.

5. A simple and efficient method of treatment is described.

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\* At least four different serological strains of leptospira have been isolated in the Andamans.—EDITOR, *I. M. G.*

resultant sloughing and absorption of the graft are such drawbacks that the surgeon is compelled to revert to his old methods\*.

Bearing these facts in mind, Lieutenant-Colonel B. F. Eminson, I.M.S., has devised a simple transgrafting operation for trichiasis and entropion of the upper lids, which meets the need of practically every case. It is a very simple one, is fit for every case in an advanced stage, and the results are permanent and satisfactory. The cosmetic defects are negligible and no complications have been seen amongst his 97 cases, operated on in the above institution.

### Technique

The patient is prepared as usual. A few drops of cocain, 4 per cent solution, are put in the cul-de-sac and an injection of 1/200 gr. hyoscine hydrobromide is given about 20 minutes before the operation. The lids are anaesthetized with 2 per cent novocain solution containing a little adrenalin chloride. About 1 c.cm. on an average is sufficient for each lid.

### Instruments

A horn-plate,  
A small scalpel,  
A forceps (dissecting or fixation),  
A pair of scissors,  
A small needle, preferably a curved one,  
A needle holder, and  
Horse-hair or silk sutures.

The assistant introduces the horn-plate below the upper lid and puts it on the stretch.

*First stage*—(a) The surgeon makes an incision in the inter-marginal space, covering its whole length, leaving 1 mm. or a little more from each canthus. The incision should be a bit deeper in the centre than on the sides, and care should be taken not to cross the roots of lashes in the incision.

(b) A second incision of the same length is made parallel to the anterior lid-margin and about  $2\frac{1}{2}$  to 3 mm. away.

(c) A third incision is made  $2\frac{1}{2}$  mm. above the second and joins with a curve at the two ends of the second incision (figure 1).

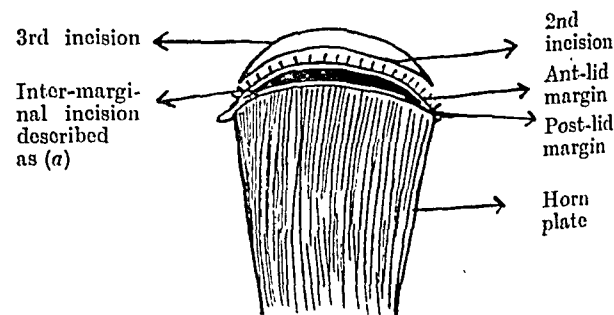


Fig. 1.—Showing three incisions.

*Second stage*—(a) The incisions 2 and 3 are deepened down (3rd being slightly more than the 2nd) until superficial fibres of orbicularis

\* Many ophthalmic surgeons will not agree with this criticism, and will prefer to support MacCallan's view that van Mulligan's operation rarely fails and is the operation of choice.—EDITOR, *I. M. G.*

are included. As the skin retracts, it results in the formation of an elliptical skin-flap in the centre of a wound on the lid surface, hereafter to be called wound 2 (figure 2).

Elliptical piece of skin

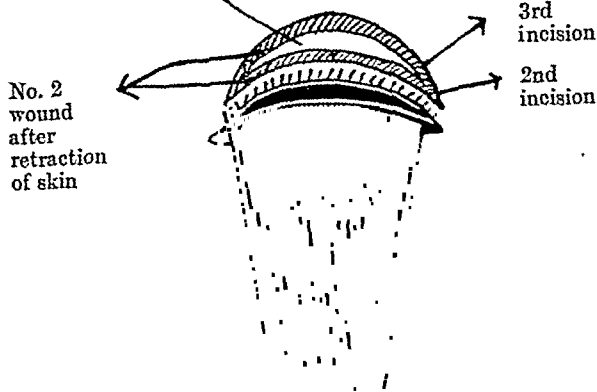


Fig. 2.—Showing deepening of incisions nos. 2 and 3 and formation of the elliptical piece of skin and wound no. 2.

(b) The distal ends of this elliptical flap of skin are now raised by dissection but the middle third is left attached (figure 3).

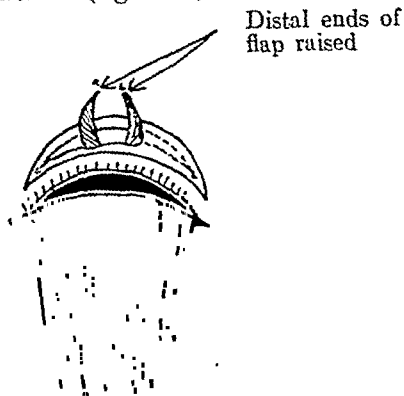


Fig. 3.—Showing distal ends of elliptical piece of skin raised and middle third attached.

*Third stage—(a)* The flap of skin lying between the inter-marginal wound and the upper wound 2 is undermined in its centre by thrusting a knife and bringing it out in the inter-marginal space, thus connecting the wounds 1 and 2, by the undermined narrow gap (figure 4). Care should be taken not to cut the roots of the lashes in the flap.

(b) The elliptical flap of skin in the upper wound is now transferred through this gap to the lower wound by catching with forceps passed through the inter-marginal space and bringing it down. It is spread and approximated in the inter-marginal wound by the ends of forceps, scissor blade or point of the knife (figure 5) where it lies securely and shows little tendency to be displaced.

*Fourth stage.*—This concludes with closing of the wound on the lid-surface (remaining after transferring the elliptical graft down to the inter-marginal space) with two simple sutures

of horse-hair or silk thread and covering with a piece of sterilized gauze soaked in sterilized vaseline (figures 6 and 7).

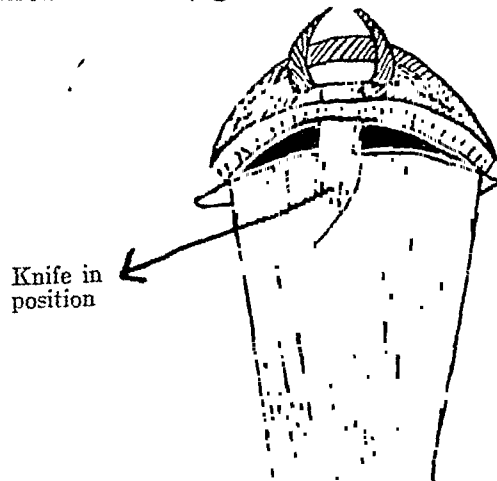


Fig. 4.—Showing formation of undermined gap with knife passed from upper wound no. 2 to inter-marginal wound.



Fig. 5.—Transferring the elliptical piece of graft with a forceps passed from the undermined gap.



Fig. 6.—Graft approximated in inter-marginal space and sutures put to upper wound.

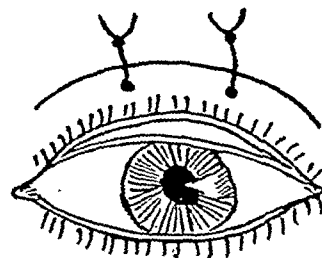


Fig. 7.—Graft and sutures both in position.  
(Concluded on next page)

# HEALTH SURVEY OF PUNJABI BOYS : SKELETAL SYSTEM, LYMPHATIC ORGANS AND CIRCULATION

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and

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Sialkot

*Subject of the study.*—A good many surveys of physical conditions and health in Indian children have been carried out (Aykroyd and Rajagopal, 1936; Aykroyd, Madhava and Rajagopal, 1938; Chatterjee, 1938; Mitra, 1939; Singh, 1939; Shourie, 1939; Wilson, 1939; Wilson and Mitra, 1938). However, the population of India is so heterogenous that it may be of value

(Continued from previous page)

*After-treatment.*—Nothing is required excepting a gentle cleaning with a sterilized saline swab every day and covering again with sterilized vaseline gauze. The graft is complete and firm, and the sutures in the upper wound should be removed on the fourth day. After that a little sterilized vaseline should be applied to the lid-margins. The graft-piece becomes gradually thinner and after a period of 6 to 8 months is smoothly incorporated with the surrounding lid-tissues.

*Advantages.*—1. It is a sound and logical operation.

2. The technique is very simple and needs no elaborate preparations nor a competent assistant.

3. There is no fear of sepsis as the transferred graft-piece is made thoroughly aseptic. It may be cleaned with spirit or even could be painted with tincture of iodine.

4. The base of the elliptical piece of graft being pedunculated, the nutrition is complete and the graft never dies.

5. The graft never gets detached with cleaning, as is the case with mucous membranes, which may be rubbed away with a swab, in an attempt to clean at the time of dressings.

6. The base being pedunculated the graft never curls, and this facilitates its approximation on the right side, whereas mucous membrane generally curls and the wrong side may be approximated, resulting in drying and subsequent death of the graft.

At first a sling-operation (in which the ends of the flap were kept attached and the centre was detached) was tried, but the flaps often sloughed and the cosmetic effects were not satisfactory. The above operation was gradually developed. It is quite probable that others may be doing a similar operation or have described one, but as it is not generally described in textbooks, and has been found so satisfactory, that it is considered worth publishing.

to add, to the surveys already carried out, one from the Punjab.

In a separate paper (Fabisch and Hamburger, 1941) we have dealt with biometrical data from more than 1,500 Punjabi boys from 5 to 20 years of age. In this paper, we propose to deal with the results of clinical examination and pathological conditions met with.

Students in a Mission High School and in Gordon College in Rawalpindi, and also in a Mission High School in Sialkot, were examined. This was a yearly routine examination. Of these groups the college students are under the most comprehensive and continuous medical supervision.

## 1. Posture

We shall discuss first the posture which is such a prominent clinical feature. We divided the examined students into four categories as to their posture so that I stands for category 'good', II for 'fair', III for 'poor' and IV for 'very poor'.

TABLE I

*Distribution of posture categories among Punjabi students*

| Category        | Gordon College, per cent | High School, per cent | Sialkot, per cent |
|-----------------|--------------------------|-----------------------|-------------------|
| I               | 31.7                     | 0.1                   | 46.0              |
| II              | 41.6                     | 27.3                  | 33.0              |
| III             | 20.2                     | 72.1                  | 19.0              |
| IV              | 6.5                      | 0.5                   | 2.0               |
| Number of cases |                          |                       |                   |
| Total: 1,594    | 675                      | 812                   | 107               |

The percentage of cases in category IV is fortunately quite low in all three institutions. The high percentage in category III and the low one in category I in the high school is due to the complete absence of physical training in these town-dwelling children. The school does not provide for physical education. The Sialkot school passes the two other groups in category I. This is due to the intensive physical training upon which this school places much importance, already in the younger classes. The situation of the school buildings outside the city and the close supervision of the boys in boarding halls might be contributing favourable factors.

An analysis of the figures of Gordon College students for separate age groups shows that category I contains more students with higher age. That might demonstrate the improvement of posture through training. The figures for category II are almost constant, while category III becomes smaller in the older classes. That is the result of shifting of students from this category to category II and from there to I, while the physical education becomes more effective.

In the high school there is only 0.1 per cent in category I. The highest percentage is found in category III and there is no improvement in the situation with increasing age.

### 2. General condition

In the classification of the children examined as to their state of general condition we followed the same plan as described in the previous paragraph.

TABLE II

*Distribution of categories of general condition*

| Category        | Gordon College, per cent | High School, per cent | Sialkot, per cent |
|-----------------|--------------------------|-----------------------|-------------------|
| I               | 57.3                     | 0.6                   | 36.0              |
| II              | 20.3                     | 46.6                  | 47.0              |
| III             | 17.2                     | 52.4                  | 15.0              |
| IV              | 5.2                      | 0.4                   | 2.0               |
| Number of cases |                          |                       |                   |
| Total: 1,582    | 650                      | 825                   | 107               |

The situation is here about the same as is found in the analysis of the posture categories. There are very few high school students in category I. This school is frequented by city children. A great number of their parents belong to economically weak classes. The children, therefore, do not enjoy the compensation of the simple though wholesome food, which comes into effect with the Sialkot children who are all of rural origin. The high percentage of college students in category I is easily explained through positive social selection.

### 3. Thorax

We have found a rosary (that is, the bead like swelling of the costal epiphyses) in 29.9 per cent of all high school boys. As the rosary is considered a sign of rickets in the earlier periods of life, we can state that nearly one-third of these boys have been subject to rickets. That compares unfavourably with the 2 per cent rickets found by Wilson (1939) in 406 Kashmiri children, although she too took account of the lesser degrees of the affection, *e.g.* enlarged epiphyses (*see also* D. C. Wilson, 1931).

There has been considerable discussion about the occurrence of rickets in tropical and subtropical areas. From literature and theoretical consideration we can conclude that living in a tropical or subtropical climate, as such, does not necessarily protect against rickets. We know that the amount of ultra-violet rays in the daylight increases with decreasing geographical latitude and increasing altitude above sea level. But this rule is modified as to the actual protective effectiveness of the ultra-violet, by various factors. Firstly, dust and vapour particles, etc., reduce the amount of ultra-violet rays which actually reach the lowest levels of

the atmosphere (Kestner and Borchardt, 1929). In most seasons the extremely dusty air of Rawalpindi is surely one of the factors responsible for the high rickets incidence observed. Secondly, provided that even in low latitude, great altitude, and clear atmosphere sufficient ultra-violet light reaches the ground, it might not become effective. Such is the case with Mohammedan women and children who under certain religious rules (*purdah* system) are almost continuously living indoors (Hutchinson). The same holds good for the women who are living in narrow valleys of Kashmir, Baltistan, and other tracts of mountainous Central Asia. These valleys are poor in light and the women succumb to the adult equivalent of rickets, osteomalacia (Wilson, *loc. cit.*). In the Elizabeth Newman Hospital, of the Church Mission Society\* in Srinagar, Kashmir, there were recorded:

TABLE III

*Occurrence of pathological deliveries due to osteomalacia in Kashmir*

| Time of observation | Total mid-wifery cases | Normal cases | Classical Caesarean   | Latzko Caesarean | Craniotomies |
|---------------------|------------------------|--------------|-----------------------|------------------|--------------|
|                     |                        |              | for contracted pelvis |                  |              |
| 17-10-38-17-10-39.  | 183                    | 123          | 17                    | 6                | 8            |
| 17-10-39-1-8-40.    | 165                    | 114          | 17                    | 7                | 8            |

All cases of pathological labour not due to osteomalacia are not included in this table. The number of craniotomies is rather too low, as some more were done, according to the records, for delayed infected labour. Some of these are probably also caused by deformed osteomalacial pelvis. But even our conservative figures show what frequency osteomalacia has in Kashmir, where rather low latitude, great altitude and clear atmosphere would let one expect a good ultra-violet supply.† Malnutrition certainly contributes to this amazing osteomalacia incidence. Thirdly, rickets may occur if the intake of provitamin is insufficient. We have found among our children many badly fed ones. It is understandable that they suffer even though enough ultra-violet reaches them. The rays do not find the provitamin in the skin to activate it into the actual vitamin D‡.

\* We are obliged to Dr. I. Friedheim, M.D., who made these data available in a personal communication.

† See also the data on Himalayan osteomalacia by G. F. Taylor and C. D. Marshall Day, 1940, *Brit. Med. Journal*, 17th Aug., 1940, p. 221.

‡ That there are other points to be considered in the aetiology of rickets is shown in papers by Mellanby and others, as discussed in the *Brit. Med. Journal*, 31st Aug., 1940, p. 292. Calcium precipitating substances in certain cereals, such as phytic acid = inositolhexosephosphoric acid, may act as rachitogenic factors.

## 4. Spine

TABLE IV

*Occurrence of spinal deformities in Punjabi students*

|                 | Scoliosis,<br>per cent                | Kyphosis,<br>per cent | Lordosis,<br>per cent | Kypho-<br>scoliosis,<br>per cent |
|-----------------|---------------------------------------|-----------------------|-----------------------|----------------------------------|
| High School ..  | 10.5                                  | 16.7                  | 17.2                  | 0.12                             |
| Gordon College  | 2.5                                   | 4.2                   | 1.0                   | 0.14                             |
| Number of cases | High School: 834, Gordon College: 693 |                       |                       |                                  |

Table IV shows the percentage in which the four deformities occur, related to the total number of cases examined.

The percentage of scoliosis in the various age classes remains in the high school at about the same level. Kyphosis increases its incidence with increasing age from 5 per cent with 5 years to 25 per cent with 14 years, indicating the deformation of the spine through prolonged studies in bad attitude. Kyphosis shows the highest incidence of these three anomalies of posture capable of correction (scoliosis, kyphosis, lordosis) among college students. Lordosis decreases from 40 per cent with 5 years to 5 per cent with 15 years. We put this in relation with the very protruding abdomen of little boys, observed so frequently. This is perhaps the result of the predominantly carbohydrate-containing and bulky diet as well as of the low tonus of the abdominal muscles.

## 5. Extremities

TABLE V

*Occurrence of anomalies of the lower extremities in Punjabi students*

| Condition                    | Gordon College   | High School       |
|------------------------------|------------------|-------------------|
| Pes planus ..                | 76 = 11 per cent | 33 = 4.9 per cent |
| Genu valgum ..               | 23               | 9                 |
| Genu varum ..                | 14               | 13                |
| Crus valgum ..               | 4                | 3                 |
| Crus varum ..                | 19               | ..                |
| Pes valgus ..                | 7                | 13                |
| Miscellaneous ..             | 3                | ..                |
| Total number of deformities. | 146              | 71                |

Among the students examined, anomalies of the lower extremities were found 146 and 71 times respectively. These figures contain also combined anomalies, as for example pes valgus and genu varum occurring in the same person. About a quarter of the observed diseases are combined. We arrived therefore at the following approximate percentages: Gordon College 16 per cent, high school 7.7 per cent. The low incidence of anomalies of the lower extremities in the high

school is remarkable, especially considering the figures of anomalies of the spinal column. The explanation for this divergent behaviour can be given as follows. The spinal deformities can be corrected with improved muscular force and exercise, that is with increasing age; therefore the high figures for the younger high school pupils than for the college students. The bulk of the foot and leg anomalies is formed by cases with pes planus from which 11 per cent of the college students suffer as compared with only 4.9 per cent of the high school boys. These anomalies require a higher body weight and more time for their development.

## 6. Teeth

TABLE VI

*Occurrence of tooth affections in Punjabi students*

| Condition                 | High School (934 boys), per cent | Gordon College (657 students) |                  |                   |                 |
|---------------------------|----------------------------------|-------------------------------|------------------|-------------------|-----------------|
|                           |                                  | Europ., per cent              | Indian, per cent | Indiff., per cent | Total, per cent |
| Affection of gums.        | 0.0                              | 22.0                          | 28.0             | 31.0              | 26.6            |
| Tartar ..                 | 54.4                             | 33.0                          | 38.0             | 42.0              | 37.1            |
| Caries (gross incidence). | 15.6                             | 13.0                          | 14.0             | 21.0              | 14.6            |

We have examined teeth and gums for three affections:—

(1) The incidence of inflammatory and regressive changes from simple gingivitis to real alveolar pyorrhœa;

(2) The occurrence of tartar deposits;

(3) The incidence of gross caries. We understand by gross caries the cavities which are visible without the help of dental instruments, using only the tongue depressor for naked-eye inspection.

We have inquired from the college students their method of oral hygiene. The use of tooth brush and tooth paste we called the European method. The Indian school method is the employment of the *miswak* or *dantan*, a twig of the neem tree (*Melia azadirachta*), or other indigenous trees if neem is not available. One end of the stick is made, through prolonged chewing, into a fairly soft crude brush which, after the chewing, is used for mechanical cleaning and gum massage. The sticks contain mainly astringent factors in the bark. Into the group 'indifferent' we have collected those who are using both methods irregularly or neglect their mouths altogether.

The absence of inflammatory gum conditions among the high school children is remarkable, as hardly any of them cleaned their teeth. The tremendously high incidence of tartar, however, prepares the field for the later common gum

affections which reach, in the college students, 26.6 per cent. The percentage of caries is almost the same in high school boys and college students. That coincides with the report of Boyd, 1940, that there is no apparent correlation between degree of cleanliness of the teeth and gums, and the tendency for caries to progress or to retrogress.

The difference, however, between the caries incidence we have found and the one in American children, as observed by Knutson, Klein and Palmer, 1940, is very big, even admitting that our figures would be higher with the use of more refined explorative methods. They found in children aged 6 years 16 per cent with one or more carious permanent teeth, and in children aged 15 years, 96 per cent. We can here but state this difference without attempting to give an explanation. A geographical analysis of the caries problem is, to date, too difficult. Many papers from all countries provide material about caries incidence (in India Wilson, Mitra, Shourie, Singh, etc., *loc. cit.*). The calculations do not always differentiate caries in deciduous and permanent teeth, others calculate the caries incidence in the total number of permanent teeth. In some papers it is not clear which diagnostic methods were used. In short, there is no common standard of examination and calculation which should allow the desired analysis.

The occurrence of the three discussed conditions remains within the same level whatever oral hygiene is employed. However, those who use the European method have the lowest incidence of all three groups of affections, perhaps not so much on account of the method employed but rather as a result of the increased attention towards teeth, earlier consultation of a dentist, and better diet.

cent with 16 years and only 2 per cent with 20 years. Interesting is the difference in the behaviour of tonsils and glands, which latter show a marked tendency to disappear spontaneously, while tonsils remain. It throws a side-light on histopathological problems. The purely lymphatic tissue of the lymph nodules reacts in a way different from the mixed lympho-epithelial tissue of the tonsils.

Comparing our figures with those found in other Indian groups, it is revealed that children from rural districts and from the Assam tea workers' families have much lower percentages, down to 9.8 per cent, while the town-dwelling children of better class or well-to-do parents in Calcutta rank above our figures, up to as much as 42.3 per cent, children with enlarged tonsils (see Mitra and Wilson and Mitra, *loc. cit.*).

### 8. Heart

In our examinations, we laid special stress upon the testing of the heart. The usual functional heart test of counting the pulse before and after certain exercise was not considered sufficient. The heart examination was in all the college students carried out as follows:—

A. Pulse rate one minute before and after 10 knee bends.

B. Percussion and auscultation.

C. Blood pressure.

D. The functional test: counting of pulse rate with the help of a stop-watch in 5 15-second intervals for one and a quarter minute. That results in a 'pulse picture' which allows one easily to see whether recovery after exercise takes place normally. The 15-second rate should come back to normal in the 5th quarter minute. Table VII shows the per-

TABLE VII  
Occurrence of unsatisfactory functional heart test

| Age and percentage     | .. | 13 | %  | 14 | %  | 15 | %  | 16  | %  | 17  | %  | 18  | %  | 19 | %  | 20 | %  | 21 | %  |
|------------------------|----|----|----|----|----|----|----|-----|----|-----|----|-----|----|----|----|----|----|----|----|
| Cases of slow recovery | .. | .. | .. | 6  | 43 | 18 | 23 | 35  | 24 | 36  | 16 | 15  | 12 | 11 | 13 | 6  | 11 | 1  | 4  |
| Number of cases ..     | .. | 3  | .. | 14 | .. | 78 | .. | 144 | .. | 141 | .. | 129 | .. | 84 | .. | 53 | .. | 24 | .. |

### 7. Tonsils and lymph nodules

One hundred and twenty-six out of 639 (= 18.2 per cent) of the college students and 23 out of 107 (= 21.6 per cent) of the Sialkot school boys showed really enlarged tonsils. We found that the percentage did not decrease with age.

One hundred and forty-five out of 834 (= 17.3 per cent) of the high school boys and 43 out of 693 (= 6.2 per cent) of the college students showed enlarged submaxillary, cervical, and/or occipital glands. Between 6 and 8 years there is a maximum with about 28 per cent of boys with enlarged glands, and a minimum of about 6 per cent between 14 and 15 years in high school boys. In college students there are 8 per

centage of students in age classes which do fulfil this recovery test satisfactorily.

Among 693 students 115 cases of slow recovery = 16.6 per cent.

The reduction of the incidence of slow recovery is perhaps too favourable a result of the physical education during college life. There were 14 cases of murmurs on auscultation, but only one case of definitely established organic lesion, *i.e.*, mitral incompetency. All 14 cases showed slow and insufficient recovery. It was perhaps a matter of chance that no more organic lesions were discovered, as in a new class of 220 students not yet included in this survey, two

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# A PRELIMINARY STUDY OF THE RIDEAL-WALKER COEFFICIENT VALUES OF CERTAIN INDIGENOUS ESSENTIAL OILS

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## Introduction

THE medicinal use of *Ocimum basilicum* Linn., *Ocimum sanctum* Linn., *Curcuma aromatica* Salisb., *Hemidesmus indicus* R. Br., *Pistacea integerrima* Stew. and *Homalomena aromatica* Schott. has long been in vogue in India. Some of these plants are considered to possess marked antiseptic properties and are empirically used for such action. Thus, the infusion of *Ocimum basilicum* is used in gonorrhœa, diarrhœa, dysentery and ringworm. The juice of *Ocimum sanctum* is supposed to cure catarrhal bronchitis and ringworm; *Curcuma aromatica* is used in conjunctivitis, otorrhœa, eruptive fevers, and scabies; *Hemidesmus indicus* in syphilis, leucorrhœa, conjunctivitis, and thrush. *Pistacea integerrima* is believed to

(Continued from previous page)

cases of organic heart diseases were found, both mitral incompetency.

The measurements of blood pressure did not prove a great help for detecting pathological conditions in such serial examinations.

## Summary

From routine clinical examinations of about 1,500 Punjabi students, data on posture, general condition, and pathological occurrences in skeletal, lymphatic, and circulatory systems are compiled.

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possess tonic and expectorant properties and is also used in psoriasis and dysentery. *Homalomena aromatica* is employed in skin diseases.

It is an established fact that essential oils sometimes show definite antiseptic properties. For instance, essential oil obtained from *Eucalyptus cneorifolia* contains different fractions, of which austrabol and crystal have carbolic coefficients, 13 and 12.5 respectively. This is also true for the thyme oil which has a carbolic coefficient of 25.

In view of these facts, it was of interest to study the Rideal-Walker coefficient values of the above-mentioned oils and to ascertain firstly what specific action they would possess against *Bacterium typhosum*, and, secondly, whether some of them could not be used as antiseptics. The unsatisfactory conditions of coal-tar distillation in India and the difficulty in obtaining the higher fractions of coal-tar derivatives for manufacturing disinfectants of high Rideal-Walker coefficient increased still more the importance of this problem. As some of these plants, such as *Ocimum* varieties, grow very extensively in India the possibility of their utilization in the manufacture of disinfectants would be of economic importance. The present paper aims at elucidating this point.

## Experimental

1. *Method of extraction of essential oils.*—Of the seven essential oils studied by us, those from *Ocimum basilicum*, *O. sanctum* and *Curcuma aromatica* were distilled in the Rakshit Laboratory, Ghazipur, and supplied to us by Mr. J. N. Rakshit. Essential oils from *Hemidesmus indicus*, *Pistacea integerrima* and *Homalomena aromatica* were extracted in the Department of Chemistry of the School. The method followed for the extraction of these oils was quite a simple and general one, and can be summarized as follows:—

The coarsely powdered drug was moistened with water and macerated. It was then distilled in steam, and the condensed water along with the essential oil collected. When the quantity of oil was sufficient to separate in a layer it was collected by means of a separating flask. When the quantity was small the distillate was salted out and then shaken up with ether. The ether was removed and the residual oil preserved.

2. *Physical and chemical constants.*—The colour of the different oils is variable. Essential oil of *O. basilicum* is light-brown in colour, of *O. sanctum* (red and green varieties) brown, of *C. aromatica* pale yellow, of *H. aromatica* yellow, of *H. indicus* brown and of *P. integerrima* light yellow. All of them possess strong aromatic odours, characteristically distinct in each case but difficult to define. The physical and chemical constants, such as the boiling point, refractive index, specific gravity, optical rotation, saponification and iodine values, of these essential oils are being studied at present. As this work is not yet complete, useful data

concerning these points could not be introduced into this paper, but will form the subject-matter of a separate communication from the Department of Chemistry.

3. *Description of the method.*—The standard technique of the British Standards Institution was followed. The Lister Institute strain of *Bact. typhosum* of 1931 was used for the test. Phenoleum of Merck was utilized as the standard for comparison. Eupeptone not being available at present, bacto-peptone (Difco) had to be substituted in the standard broth media.

The preparation of different dilutions of the essential oils was done in sterile distilled water, using triethanolamine oleate, 1 gm. per 100 c.cm. of solution, as the emulsifying agent.

The mean results of our experiments are given in the table :—

TABLE

The comparative Rideal-Walker coefficients of seven essential oils of indigenous origin

| Name of oil                       | Carbolic coefficient |
|-----------------------------------|----------------------|
| 1. <i>Ocimum basilicum</i> ..     | 7                    |
| 2. " <i>sanctum</i> (green) ..    | 6                    |
| 3. " " (red) ..                   | 3                    |
| 4. <i>Curcuma aromatica</i> ..    | < 1                  |
| 5. <i>Hemidesmus indicus</i> ..   | < 1                  |
| 6. <i>Pistacea integerrima</i> .. | < 1                  |
| 7. <i>Homalomena aromatica</i> .. | < 1                  |

#### Discussion

It is evident from the table that, of the seven essential oils, judged from the standpoint of Rideal-Walker coefficient values, the *Ocimum* group proved to be the most potent, *O. basilicum* and *O. sanctum* (green variety) showing carbolic acid coefficients of 7 and 6 respectively may be considered to have quite appreciable antiseptic properties against *Bact. typhosum*. This value compares very favourably with that of many disinfectants manufactured by local firms, which show lower figures.

The carbolic coefficient of *Ocimum sanctum* (red) is only 3 and that of *Curcuma aromatica*, *Hemidesmus indicus*, *Pistacea integerrima* and *Homalomena aromatica* is about 1. It would naturally be useless to investigate any further the disinfecting properties of this latter group. Whether they possess any specific bactericidal action against some other organisms, *in vitro* or *in vivo*, is a question which could be settled only by further investigation.

#### Conclusions

1. The Rideal-Walker coefficient values of seven indigenous essential oils have been studied for the first time by following closely the standard method for the test.

2. The family *Ocimum* and especially *basilicum* and *sanctum* (green) showed definite antiseptic properties against *Bact. typhosum*.

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## LATENT SYPHILIS AND FALSE-POSITIVE WASSERMANN REACTION IN THE TROPICS

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IN a previous communication (Grevall, Sen Gupta and Das, 1938) it was shown that (i) latent syphilis was encountered in an unselected hospital population rather infrequently, (ii) that many conditions other than syphilis were responsible for a positive Wassermann reaction, and that (iii) the Wassermann-positive rate in an unselected Indian population was likely to be under 10.25 per cent rather than 20 to 22 per cent of the previous writers. The work commenced in connection with the aforesaid items, in the Carmichael Hospital for Tropical Diseases, Calcutta, in 1937, has been continued. More figures are now available. They confirm the previous findings and reduce the Wassermann-positive rate still further.

Wassermann reaction of 1,525 cases admitted for diseases other than syphilis

The reaction was in the majority of cases repeated at intervals. The accompanying

(Continued from previous column)

3. This action appeared to be negligible with *Ocimum sanctum* (red), *Curcuma aromatica*, *Hemidesmus indicus*, *Pistacea integerrima* and *Homalomena aromatica*.

4. It is suggested that further studies on the specific action of the essential oils of *Ocimum basilicum* and *Ocimum sanctum* be made in the treatment of infections for which they are now being only empirically used.

#### Acknowledgments

Our thanks are due to Mr. J. N. Rakshit, Prof. S. Ghosh, and his staff for the extraction of these essential oils.

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tabular statement gives the initial and subsequent reactions of two series of cases.

The cases with 3 possible exceptions (obscure nervous complaint suspected to be syphilitic and treated with malaria) were suffering from diseases other than syphilis.

The technique of the reaction was that of No. 4 of the Medical Research Committee, 1918, (now Council) modified and standardized by the senior writer (Greval, *et al.*, 1930, 1938, 1939, 1940). The essential features of the technique are: (i) the quantity of complement added to the serum control is 2 M.H.D., (ii) red cell suspension and antigen are standardized, (iii) complement is classified, (iv) antigen-complement system is adjusted according to the class of the complement found, (v) repeatable, therefore comparable, reading is obtained by the aid of titrated controls of pooled positive sera, and (vi) a positive reaction with 4 M.H.D. of complement and uncholesterinized antigen is termed +++.

In the tabular statement the last but one item, 'finally positive or doubtful' reaction, is recorded to make the result comparable with those of treated syphilis: the persisting doubtful reaction of a recently treated case of syphilis still indicates a diagnosis of syphilis; on the other hand, an initial doubtful reaction in the absence of presumption of syphilis does not indicate a diagnosis of syphilis. For the purpose of detecting the false-positive Wassermann reaction the last item, 'finally positive (excluding doubtful)', gives the desired figure.

Two series are tabulated separately to bring out the variations such figures are subject to; statistical analysis, involving mathematical refinements, is not attempted.

The following points emerged:—

(i) Percentage of +++ cases is low. It is  $\frac{100 \times 11}{1,525} = 0.72$ . In the Wassermann register of this laboratory which undertakes serological work for nearly all hospitals and clinics in Calcutta, and which tested 15,615 sera in 1939-40, it is of the order of 6. Probably +++ cases give a truer latent syphilis rate than other cases, although this reaction has been encountered in at least one non-syphilitic case (Greval, *loc. cit.*). In series one, the reaction of half of such cases fell to ++ without anti-syphilitic treatment.

(ii) Of 90 ++ cases, 24 could not be repeated: of the remaining 66, 21 became negative and 9 doubtful ( $\pm$ ) without anti-syphilitic treatment.

(iii) Of 33 + cases, 3 could not be repeated: of the remaining 30, 17 became negative and 5 ( $\pm$ ) without anti-syphilitic treatment.

(iv) Of 63  $\pm$  cases, 20 could not be repeated: of the remaining 43, 28 became negative without anti-syphilitic treatment.

(v) There was a rise in reaction too during the course of the disease. Two reactions rose from ++ to +++, 4 from + to ++, 8 from

$\pm$  to + or ++. This rise is as much a proof of the non-specific nature of the reaction as the fall in ii, iii and v.

*Conditions other than syphilis responsible for a positive Wassermann reaction*

The following conditions have been held responsible for a false-positive reaction:—

1. Other diseases—leprosy, yaws, malaria, trypanosomiasis, pinta and bejel frequently. Septicæmia, endocarditis, pneumonia, tuberculosis, relapsing fever, spotted fever, typhus fever, scarlet fever, infectious mononucleosis, pernicious anæmia, leukæmia, xanthomatosis, severe jaundice and lymphopathia venereum less frequently. Others very infrequently.

2. Bacterial growth in serum.

3. Excess fat and digestive products in serum.

4. Passive transfer from mother.

5. High barometric pressure increases tendency.

6. Improperly prepared, titrated and mixed reagents.

7. Probably some 'cured' cases of syphilis (Smith, 1940).

Item no. 6 may be eliminated. It is not likely to interfere in a standardized technique.

Attention is drawn to three other conditions: (i) kala-azar, (ii) 'lecithinophile eosinophilia' and (iii) 'lecithinophile hepato-gastro-intestinal syndrome'. The first two conditions have been discussed previously (Greval, Sen Gupta and Napier, 1939; Greval, 1940): the third will be summarized briefly now:—

Lecithinophile hepato-gastro-intestinal syndrome.

It is a state of ill health (i) characterized by chronic indigestion, distention after food, looseness of bowels or constipation, enlargement of liver with or without jaundice, discomfort or diffuse pain in the epigastrium or right hypochondrium, low fever, loss of weight, anæmia and a positive or doubtful Wassermann reaction, and (ii) not covered by a definite diagnosis of a known disease of the digestive system or of syphilis. All the signs and symptoms may not and usually do not occur together. A strong enough combination in the absence of the usual manifestations of syphilis, however, establishes the presumption that one is not dealing with intentionally concealed, naturally latent or congenital syphilis, but with a more-or-less chronic and hitherto undescribed disease or disorder of the digestive system. The presumption is converted into proof when the positive or doubtful reaction weakens and disappears with the improvement and reappears with the relapse.

The condition is non-syphilitic. The positive or doubtful Wassermann reaction is false. It will be better to call the reaction simply an affinity of the blood for lecithin in complement fixation. Hence the adjective lecithinophile.

The disappearance and reappearance of the positive (or doubtful) reaction are too rapid and intimately connected with the characteristic clinical symptoms to be regarded as the usual

variations in a true positive Wassermann reaction due to meteorological causes (Hoverson, *et al.*, 1935) and even passage of time (Becker, 1937). Variations due to qualitative differences in the complement are effectively controlled by the adjustment of the antigen-complement system in the writers' technique (Greval, Chandra and Das, *loc. cit.*).

The writers have read with great interest a publication by Bakhsh (Bakhsh, 1940) on gastro-intestinal disorders related to liver. The Wassermann reaction, however, was not done on the cases reported (private communication from Bakhsh).

The syndrome attracted the senior writer's attention some time ago and was mentioned in two communications quoted in the present communication but was not then so named. A communication on this item alone has been sent abroad, but it is not yet known whether it reached its destination and will be published.

#### *The Wassermann-positive rate in an unselected Indian population*

Twenty-two per cent (Iyengar, 1919) and 20 per cent (Lloyd, Napier and Mitra, 1930) were the positive rates given by previous workers. The rate calculated from the figures collected in this communication is :—

$$1,525 : 100 : 134 = \frac{13,400}{1,525} = 8.7 \text{ per cent, crude}$$

$$\text{or}$$

$$1,525 : 100 : 82 = \frac{8,200}{1,525} = 5.3 \text{ per cent, corrected.}$$

The crude rate is based on the number found positive initially. The corrected rate is based on the number found positive finally, with the improvement in the disease the patients were suffering from *and without anti-syphilitic treatment*. The period of observation was limited. It is reasonable to suppose that an extension of the period will reduce the corrected figure further. The true-positive rate, indicative of latent syphilis, must be below 5.3 per cent. Only this figure will be compatible with the economic and social orders of things in India. Nearly everybody of marriageable age in this country is married and his main concern is food, not gratification of illicit sexual desires.

Besides, this figure is a figure for a town. The figure for the country, where the scope of irregularities of human conduct is much smaller than in towns, will be lower.

The reasons for previous workers' high rate appear to be two : (i) the technique did not at times differentiate between a doubtful and a positive reaction, and (ii) the reactions of cases suffering from certain diseases were not repeated.

#### *Presumption of syphilis in Wassermann-positive cases and latent syphilis rate*

Of the 134 initially positive and 63 doubtful cases in the two series, signs and history of

syphilis could only be obtained in 23 cases distributed as follows :—

|     | 1st series | 2nd series |
|-----|------------|------------|
| +++ | 4          | 2          |
| ++  | 5          | 8          |
| +   | 1          | 1          |
| ±   | 2          | 0          |
|     | <hr/> 12   | <hr/> 11   |

As these cases were admitted for diseases other than syphilis, 23 per 1,525 or  $\frac{100 \times 23}{1,525} = 1.5$  per cent could be regarded as the latent syphilis rate, provided other causes leading to a false-positive reaction in a cured case of syphilis could be eliminated.

The true ascertainable latent syphilis rate must be under 1.5 per cent.

#### *Summary*

1. Wassermann reaction of 1,525 cases admitted for diseases other than syphilis is tabulated. Some positive reactions disappeared, others weakened with the improvement in the

#### *A tabular statement of Wassermann reaction of two series of cases totalling 1,525*

| Series .. ..                           | I                 | II                 |
|--|-------------------|--------------------|
| Period .. ..                           | 10-7-39 to 9-7-40 | 10-7-40 to 15-4-41 |
| +++ :-                                 | 6 :-              | 5 :-               |
| Not repeated ..                        | 1                 | 1                  |
| Same reaction ..                       | 2                 | 4                  |
| Fell to ++ ..                          | 3                 | nil                |
| ++ :-                                  | 36 :-             | 54 :-              |
| Not repeated ..                        | 8                 | 16                 |
| Same reaction ..                       | 9                 | 17                 |
| Rose to +++ ..                         | 1                 | 1                  |
| Fell to + ..                           | 5                 | 3                  |
| Fell to ± ..                           | 5                 | 4                  |
| Turned - ..                            | 8                 | 13                 |
| + :-                                   | 21 :-             | 12 :-              |
| Not repeated ..                        | nil               | 3                  |
| Same reaction ..                       | 3                 | 1                  |
| Rose to ++ ..                          | 4                 | nil                |
| Fell to ± ..                           | 3                 | 2                  |
| Turned - ..                            | 11                | 6                  |
| ± :-                                   | 41 :-             | 22 :-              |
| Not repeated ..                        | 13                | 7                  |
| Same reaction ..                       | 6                 | 1                  |
| Rose to ++ ..                          | 3                 | 2                  |
| Rose to + ..                           | 1                 | 2                  |
| Turned - ..                            | 18                | 10                 |
| - :-                                   | 785               | 563                |
| Total tested :—                        | 869 :-            | 656 :-             |
| Initially positive, ++++, ++ and +.    | 63                | 71                 |
| Finally positive or doubtful.          | 44                | 52                 |
| Finally positive (excluding doubtful). | 36                | 46                 |

(Concluded on next page)

# THE EFFECT OF STOCKING RICEFIELDS WITH SULLAGE ON ANOPHELINE BREEDING AT KHURDA ROAD

By V. VENKAT RAO, M.R.San.I. (Lond.)

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THE report of a preliminary experiment on the effect of stocking ricefields at Khurda Road with sullage during the dry season, on anopheline breeding, was published in the *Indian Medical Gazette* (Rao, 1941). As the results were promising, it was considered necessary to repeat the

(Continued from previous page)

patients' conditions and without antisymphilitic treatment. Some doubtful and positive reactions grew stronger without any manifestation of syphilis.

2. Attention is drawn to three conditions responsible for a false-positive Wassermann reaction: (i) kala-azar, (ii) 'lecithinophilia' and (iii) 'lecithinophile hepato-gastro-intestinal syndrome'.

3. Wassermann-positive rate for unselected Indian population, indicative of syphilis, must be below 5.3 per cent for towns. For the country it should be lower.

4. The ascertainable latent syphilis rate for the cases admitted, as judged by the Wassermann-positive rate, was 1.5 per cent. It must be really lower.

The reaction given collectively opposite the signs are the initial reactions, not those observed later as a result of rise or fall.

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experiment on a large scale, not only to confirm the previous findings, but also to ascertain the effects of this method on the rice crop.

It has been recognized that naturalistic methods of malaria control are of particular importance because they have special adaptability to rural areas, where, up to the present time, little or nothing has been accomplished (Hackett *et al.*, 1938). Naturalistic measures are even of greater importance in those rural areas where the local vectors breed in large numbers in ricefields. On account of their great extent, ricefields are very costly to deal with. They cannot be effectively drained away in those large areas where the flooding of rice is entirely dependent on an intermittent seasonal rainfall (Hackett, *et al.*, *loc. cit.*). Even in areas that can boast of an irrigation system, drying of fields for two or three consecutive days in each week cannot be effective during periods of daily rainfall (Russell and Rao, 1940). The use of chemical larvicides in ricefields frequently leads to opposition, which, though groundless, is difficult to overcome. Therefore, any antilarval measures, which do away with chemical larvicides and which do not interfere with the irrigation of the ricefields, are to be welcomed.

Rice cultivation is not properly carried out in many areas where malaria exists to any marked degree. The fields are not well manured or ploughed in the dry season, which results in a poor crop. The *ryots*, therefore, continue to be poor, and, as a result of lowered resistance to disease, they fall easy victims to malaria. The whole thing moves in a vicious circle. 'Malaria, weak men, late ploughing, more anophelines, poorer food, more malaria' (Senior White, 1936). Any method, which prevents breeding of anopheline vectors without the aid of chemical larvicides and which, at the same time, improves the rice crop, is desirable.

Besides better crop and malaria control, there are other considerations too. In most villages, sullage accumulates near houses or is allowed to run to waste and, in any case, it is not only not disposed of in a proper manner but it is allowed to become a positive nuisance. Sullage waters are eminently suitable for the breeding of *C. fatigans*, which carries the infection of filariasis. Any method which attempts to dispose of the sullage satisfactorily constitutes an improvement in rural sanitation, besides controlling filariasis, which is widely prevalent in certain parts of Madras and Orissa.

The place where this experiment (as the previous one) was carried out is Khurda Road, a railway settlement on the east coast of India, about 280 miles south of Calcutta. The sullage from this settlement empties itself into a *kutcha* drain, which passes through a large number of ricefields and is finally led into the Daya river, one of the deltaic branches of the Mahanadi. Usually, the *ryots* divert the sullage into their fields during the dry season, to facilitate ploughing. When they take the sullage, they do not

take the small quantity sufficient for wetting the soil but try to allow as much sullage as possible to run into the fields and thus convert each field into a sullage swamp, breeding *C. fatigans* in large numbers. It is, therefore, not surprising that many of the local inhabitants suffer from filariasis. Besides filariasis, malaria also exists here, as it does all along the coast-line from Berhampore to Balasore. This station, therefore, offers unique facilities for carrying out an experiment of this nature.

Ten contiguous ricefields along the *kutcha* main sullage outfall drain away from the railway malaria control limits were selected for this experiment, which was conducted throughout under the guidance of the malariologist and assistant malariologist of the B. N. Railway and under the supervision of a committee consisting of Mr. P. D. Dixit, M.Sc., paddy specialist, Orissa, Dr. R. G. Panigrahi, M.B., B.S., D.P.H., malaria officer, Orissa, and the present author. The ricefields were consecutively numbered and fields 1, 3, 5, 7 and 9 were selected for stocking with sullage, while fields 2, 4, 6, 8 and 10 were selected as 'control' fields. Sullage was allowed into the former set of fields on the following dates :—

|         |         |         |         |
|---------|---------|---------|---------|
| 17-2-41 | 3-3-41  | 7-4-41  | 5-5-41  |
| 24-2-41 | 10-3-41 | 14-4-41 | 12-5-41 |
|         | 17-3-41 | 21-4-41 | 17-5-41 |
|         | 24-3-41 | 28-4-41 |         |
|         | 31-3-41 |         |         |

As Mr. Dixit, one of the members of the committee, suggested that the composition of the sullage was likely to vary from time to time in the same day and that the stocking should be done always between 8 a.m. and 10 a.m., when the 'concentration' is at his highest, any fields which could not be 'treated' with sullage during that time on the above dates were so 'treated' on the next day.

The depth of sullage allowed in each field was not less than  $\frac{1}{2}$  inch or more than one inch. On 24th March and 31st March, 1941, however, sullage was allowed to a depth of  $\frac{1}{4}$  inch only as less sullage was available, due to its diversion elsewhere by engineers while converting part of the *kutcha* drain into a *pucca* one.

The sullage flowing into the main outfall drain near the experimental fields was chemically examined in February and again in May, while the sullage stocking was in progress. The results of the chemical examination were as shown in table I\*.

It was pointed out by the chemist who carried out the above examinations that there was a noticeable lack of nitrates in the sullage. The author, however, observed that crude 'untreated' sullage, which was not yet subjected to bacterial action, would contain complex nitrogenous organic matter, which would reduce itself into

simpler nitrates, only after such action took place. In the present case, such action would take place in the soil after the sullage was

TABLE I

|                            | 24-2-41 | 28-5-41 |                   |
|----------------------------|---------|---------|-------------------|
| Solids in suspension ..    | 8.6     | 10.8    | In 100,000 parts. |
| Free and saline ammonia .. | 14.5    | 16.0    |                   |
| Aluminoid ammonia ..       | 7.2     | 0.82    |                   |
| Nitrates ..                | nil     | nil     |                   |
| Nitrites ..                | 1       | nil     |                   |
| B.O.D. at 18°C. ..         | 4.5     | 1.0     |                   |
| pH value ..                | 7.0     | 7.2     |                   |

allowed to soak into the soil and it was, therefore, suggested that the soils taken from one 'treated' and one 'control' field might be examined. This was done with the result shown in Table II.

TABLE II

| Date    | Soil from          | Nitrates |                   |
|---------|--------------------|----------|-------------------|
| 28-5-41 | Field I 'treated'  | 0.68     | In 100,000 parts. |
| 28-5-41 | Field II 'control' | 0.12     |                   |

As neither the 'treated' nor the 'control' fields were given any manure throughout the dry season in which the sullage stocking took place, the higher amount of nitrates present in the 'treated' fields should be due solely to the addition of sullage to the fields.

All the 'treated' fields became dry 2 to 3 days after sullage was allowed into them. On a few occasions, however, the fields continued to be wet for 4 days during April and May, due to stray summer showers, which added rain water to the bulk of the sullage. Thus, the fields were invariably dry for a major part of the week and there was absolutely no chance for the successful breeding of *C. fatigans* in any of them.

Ploughing in the dry season is good agriculture as that would allow the soil to be 'aerated' and lead to a better crop. But all the *ryots* in the area do not plough the fields even once in the dry season, due to poverty or ignorance or both. Some do not plough because they should use sullage for wetting the soil beforehand and considerations of 'orthodoxy' prevent their touching sullage. The *ryots* of the ten experimental fields were encouraged to plough their respective plots at least once in the dry season but many

TABLE III

| Field number | 'Treated' or 'control' | Date or dates on which ploughing was done |
|--------------|------------------------|---|
| I            | 'Treated'              | 24-2-41                                   |
| III          | "                      | 24-2-41 and 3-3-41                        |
| IV           | 'Control'              | 3-3-41                                    |
| VI           | "                      | 19-5-41                                   |

of them could not be so induced. The dates on which such ploughing was done in the fields, if any, are shown in table III.

\* The author is indebted to Mr. S. C. Mukherji, B.Sc., Public Health Chemist, B. N. Railway, for the chemical examinations of sullage and soils.



The effects of dry season ploughing will be discussed later in this paper.

As one of the main objects of these experiments is to ascertain the effect of sullage stocking on the rice crop, and as the *ryots* of different fields use different varieties of paddy on their respective fields, which would render comparison difficult, paddy 812 was purchased by the B. N. Railway from the Government Agricultural Farm at Cuttack and supplied free of charge to all the owners of the ten experimental fields, for sowing. This paddy was accordingly sown in all the fields about the middle of June, when the south-west monsoon set in. In this part of Orissa, the rice is 'broadcast' in the fields and

not 'transplanted'. The broadcasting was done in an identical manner in all the fields.

All the fields were irrigated with rain water only, there being no seepages in any of them. In addition to rain water, surplus water from adjacent fields situated on a slightly higher level was occasionally led into these fields whenever necessity arose for partial drainage in those fields. About the middle of November, due to flood following heavy showers, field 2 was partially inundated, and field 9 'treated' and field 10 'control' were more or less completely damaged.

Larval samplings were made in all the ten fields from 1st July, 1941 to 30th November,

TABLE IV

| Plot number                     | 'Treated' or 'control' | Month    | <i>A. barbiostris</i> | <i>A. hyrcanus</i> | <i>A. subpictus</i> | <i>A. vagus</i> | <i>A. culicifacies</i> | <i>A. aconitus</i> | <i>A. varuna</i> | <i>A. annularis</i> | <i>A. pallidus</i> | <i>A. tessellatus</i> |
|---------------------------------|------------------------|----------|-----------------------|--------------------|---------------------|-----------------|------------------------|--------------------|------------------|---------------------|--------------------|-----------------------|
| I<br>I<br>I<br>I<br>I           | T<br>T<br>T<br>T<br>T  | July ..  | ..                    | ..                 | 37                  | 3               | ..                     | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | Aug. ..  | ..                    | ..                 | 115                 | 11              | 2                      | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | Sept. .. | 1                     | ..                 | 69                  | 38              | ..                     | ..                 | ..               | 1                   | ..                 | ..                    |
|                                 |                        | Oct. ..  | ..                    | 15                 | 50                  | 34              | ..                     | ..                 | ..               | 1                   | ..                 | ..                    |
|                                 |                        | Nov. ..  | ..                    | 30                 | ..                  | 4               | ..                     | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | TOTAL .. | 1                     | 45                 | 271                 | 90              | 2                      | ..                 | ..               | 2                   | ..                 | ..                    |
| III<br>III<br>III<br>III<br>III | T<br>T<br>T<br>T<br>T  | July ..  | ..                    | ..                 | 84                  | 5               | ..                     | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | Aug. ..  | ..                    | 2                  | 85                  | 26              | 2                      | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | Sept. .. | ..                    | 1                  | 62                  | 25              | 1                      | ..                 | ..               | 1                   | ..                 | ..                    |
|                                 |                        | Oct. ..  | ..                    | 5                  | 10                  | 18              | ..                     | ..                 | ..               | 1                   | ..                 | ..                    |
|                                 |                        | Nov. ..  | ..                    | 19                 | ..                  | 1               | ..                     | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | TOTAL .. | ..                    | 27                 | 241                 | 75              | 3                      | ..                 | ..               | 2                   | ..                 | ..                    |
| V<br>V<br>V<br>V<br>V           | T<br>T<br>T<br>T<br>T  | July ..  | ..                    | ..                 | 52                  | 7               | ..                     | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | Aug. ..  | ..                    | 2                  | 46                  | 8               | 1                      | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | Sept. .. | ..                    | ..                 | 60                  | 11              | 4                      | ..                 | ..               | 1                   | ..                 | ..                    |
|                                 |                        | Oct. ..  | ..                    | 8                  | 4                   | 14              | ..                     | ..                 | ..               | 1                   | ..                 | ..                    |
|                                 |                        | Nov. ..  | ..                    | 15                 | ..                  | ..              | ..                     | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | TOTAL .. | ..                    | 25                 | 162                 | 40              | 5                      | ..                 | ..               | 2                   | ..                 | ..                    |
| VII<br>VII<br>VII<br>VII<br>VII | T<br>T<br>T<br>T<br>T  | July ..  | ..                    | ..                 | 54                  | 16              | 1                      | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | Aug. ..  | ..                    | ..                 | 60                  | 12              | 1                      | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | Sept. .. | ..                    | 1                  | 59                  | 28              | 1                      | ..                 | ..               | 2                   | ..                 | ..                    |
|                                 |                        | Oct. ..  | ..                    | 16                 | 7                   | 13              | ..                     | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | Nov. ..  | ..                    | 17                 | ..                  | 3               | ..                     | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | TOTAL .. | ..                    | 34                 | 180                 | 72              | 3                      | ..                 | ..               | 2                   | ..                 | ..                    |
| IX<br>IX<br>IX<br>IX<br>IX      | T<br>T<br>T<br>T<br>T  | July ..  | ..                    | ..                 | 41                  | 6               | ..                     | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | Aug. ..  | ..                    | 1                  | 75                  | 11              | 1                      | ..                 | ..               | 1                   | ..                 | ..                    |
|                                 |                        | Sept. .. | ..                    | 4                  | 53                  | 16              | ..                     | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | Oct. ..  | ..                    | 16                 | 18                  | 16              | ..                     | ..                 | ..               | 1                   | ..                 | ..                    |
|                                 |                        | Nov. ..  | ..                    | 31                 | ..                  | 4               | ..                     | ..                 | ..               | ..                  | ..                 | ..                    |
|                                 |                        | TOTAL .. | ..                    | 52                 | 187                 | 53              | 1                      | ..                 | ..               | 2                   | ..                 | ..                    |

1941, by the same man throughout. To conform with the practice of the previous experiment, in each sampling, 25 ladle dips were made in each field once in every week. The dips were made mostly at the edges, as the *ryots* were unwilling to let us walk over the fields in search of larvæ in the centre of the fields, lest the plants should be damaged. It is emphasized that this is not a satisfactory method of larval estimation and it was adopted for want of better methods. However, almost all the paddy-field-breeding larvæ were found in these samplings, which indicates that the method adopted is not very defective. The larvæ collected from each 'treated' field are shown in table IV.

The larvæ collected from each 'control' field are shown in table V.  
The larval collections from all 'treated' fields are shown month by month in table VI, while the corresponding collections from all 'control' fields are shown in table VII.

It may be mentioned here that the larval collection made on the 1st of October was spoiled in the laboratory before the larvæ could be identified. As a result of floods, no larval collection was possible on the 15th of November and there were no larvæ in any field on the 25th of November, as the water was drained away preparatory to the harvest. Thus, four collections were made in each of the first three months

TABLE V

| Plot number                          | 'Treated' or 'control' | Month    | <i>A. barbirostris</i> | <i>A. hyrcanus</i> | <i>A. subpictus</i> | <i>A. vagus</i> | <i>A. cuticiacies</i> | <i>A. aconitus</i> | <i>A. varuna</i> | <i>A. annularis</i> | <i>A. pallidus</i> | <i>A. tessellatus</i> |
|--------------------------------------|------------------------|----------|------------------------|--------------------|---------------------|-----------------|-----------------------|--------------------|------------------|---------------------|--------------------|-----------------------|
| II<br>II<br>II<br>II<br>II           | C<br>C<br>C<br>C<br>C  | July ..  | ..                     | ..                 | 47                  | 11              | 1                     | ..                 | ..               | 16                  | ..                 | ..                    |
|                                      |                        | Aug. ..  | ..                     | ..                 | 101                 | 20              | 9                     | ..                 | ..               | 15                  | 1                  | ..                    |
|                                      |                        | Sept. .. | 2                      | 13                 | 26                  | 8               | 5                     | 7                  | 1                | 18                  | ..                 | ..                    |
|                                      |                        | Oct. ..  | 1                      | 18                 | 7                   | 16              | ..                    | 4                  | ..               | 6                   | ..                 | ..                    |
|                                      |                        | Nov. ..  | ..                     | 11                 | ..                  | 4               | ..                    | ..                 | ..               | ..                  | ..                 | ..                    |
|                                      |                        | TOTAL .. | 3                      | 42                 | 181                 | 59              | 15                    | 11                 | 1                | 55                  | 2                  | ..                    |
| IV<br>IV<br>IV<br>IV<br>IV           | C<br>C<br>C<br>C<br>C  | July ..  | ..                     | ..                 | 32                  | 6               | 13                    | ..                 | ..               | 13                  | ..                 | ..                    |
|                                      |                        | Aug. ..  | ..                     | ..                 | 49                  | 4               | 2                     | ..                 | ..               | 17                  | 2                  | ..                    |
|                                      |                        | Sept. .. | 2                      | 16                 | 23                  | 11              | ..                    | 6                  | ..               | 20                  | ..                 | 1                     |
|                                      |                        | Oct. ..  | ..                     | 11                 | 9                   | 11              | ..                    | 3                  | ..               | 6                   | ..                 | ..                    |
|                                      |                        | Nov. ..  | ..                     | 22                 | ..                  | ..              | ..                    | ..                 | ..               | ..                  | ..                 | ..                    |
|                                      |                        | TOTAL .. | 2                      | 49                 | 113                 | 32              | 15                    | 9                  | ..               | 56                  | 2                  | 1                     |
| VI<br>VI<br>VI<br>VI<br>VI           | C<br>C<br>C<br>C<br>C  | July ..  | ..                     | ..                 | 48                  | 6               | 9                     | ..                 | ..               | 24                  | 3                  | ..                    |
|                                      |                        | Aug. ..  | ..                     | ..                 | 51                  | 6               | 17                    | ..                 | ..               | 19                  | 2                  | ..                    |
|                                      |                        | Sept. .. | 4                      | 15                 | 14                  | 6               | 4                     | 7                  | 1                | 14                  | ..                 | 1                     |
|                                      |                        | Oct. ..  | 1                      | 13                 | 2                   | 14              | ..                    | 9                  | ..               | 8                   | ..                 | ..                    |
|                                      |                        | Nov. ..  | ..                     | 7                  | ..                  | 2               | ..                    | ..                 | ..               | ..                  | ..                 | ..                    |
|                                      |                        | TOTAL .. | 5                      | 44                 | 115                 | 34              | 30                    | 16                 | 1                | 65                  | 5                  | 1                     |
| VIII<br>VIII<br>VIII<br>VIII<br>VIII | C<br>C<br>C<br>C<br>C  | July ..  | ..                     | ..                 | 50                  | 1               | 4                     | ..                 | ..               | 23                  | ..                 | ..                    |
|                                      |                        | Aug. ..  | ..                     | ..                 | 55                  | 11              | 4                     | ..                 | ..               | 22                  | 1                  | ..                    |
|                                      |                        | Sept. .. | 2                      | 17                 | 37                  | 4               | 6                     | 12                 | 1                | 20                  | ..                 | ..                    |
|                                      |                        | Oct. ..  | ..                     | 18                 | 7                   | 15              | ..                    | 5                  | ..               | 5                   | ..                 | ..                    |
|                                      |                        | Nov. ..  | ..                     | 18                 | 4                   | 5               | ..                    | ..                 | ..               | ..                  | ..                 | ..                    |
|                                      |                        | TOTAL .. | 2                      | 56                 | 153                 | 36              | 14                    | 17                 | 1                | 70                  | 1                  | ..                    |
| X<br>X<br>X<br>X<br>X                | C<br>C<br>C<br>C<br>C  | July ..  | ..                     | ..                 | 27                  | 3               | 4                     | ..                 | ..               | 18                  | 1                  | ..                    |
|                                      |                        | Aug. ..  | ..                     | ..                 | 36                  | 6               | 10                    | ..                 | ..               | 24                  | ..                 | 1                     |
|                                      |                        | Sept. .. | 3                      | 17                 | 35                  | 4               | 4                     | 13                 | 1                | 19                  | ..                 | ..                    |
|                                      |                        | Oct. ..  | ..                     | 13                 | 5                   | 10              | ..                    | 10                 | ..               | 8                   | ..                 | ..                    |
|                                      |                        | Nov. ..  | ..                     | 14                 | 2                   | 5               | ..                    | ..                 | ..               | ..                  | ..                 | ..                    |
|                                      |                        | TOTAL .. | 3                      | 48                 | 105                 | 28              | 18                    | 23                 | 1                | 69                  | 1                  | 1                     |

TABLE VI  
'Treated' fields

| Month    | <i>A. barbi-rostris</i> | <i>A. hyrcanus</i> | <i>A. sub-pictus</i> | <i>A. vagus</i> | <i>A. culici-facies</i> | <i>A. aconit-us</i> | <i>A. varuna</i> | <i>A. annu-laris</i> | <i>A. pallidus</i> | <i>A. tessella-tus</i> |
|----------|-------------------------|--------------------|----------------------|-----------------|-------------------------|---------------------|------------------|----------------------|--------------------|------------------------|
| July ..  | ..                      | ..                 | 268                  | 37              | 1                       | ..                  | ..               | ..                   | ..                 | ..                     |
| Aug. ..  | ..                      | 5                  | 381                  | 68              | 7                       | ..                  | ..               | 1                    | ..                 | ..                     |
| Sept. .. | 1                       | 6                  | 303                  | 118             | 6                       | ..                  | ..               | 5                    | ..                 | ..                     |
| Oct. ..  | ..                      | 60                 | 89                   | 95              | ..                      | ..                  | ..               | 4                    | ..                 | ..                     |
| Nov. ..  | ..                      | 112                | ..                   | 12              | ..                      | ..                  | ..               | ..                   | ..                 | ..                     |
| TOTAL .. | 1                       | 183                | 1,041                | 330             | 14                      | ..                  | ..               | 10                   | ..                 | ..                     |

TABLE VII  
'Control' fields

| Month    | <i>A. barbi-rostris</i> | <i>A. hyrcanus</i> | <i>A. sub-pictus</i> | <i>A. vagus</i> | <i>A. culici-facies</i> | <i>A. aconit-us</i> | <i>A. varuna</i> | <i>A. annu-laris</i> | <i>A. pallidus</i> | <i>A. tessella-tus</i> |
|----------|-------------------------|--------------------|----------------------|-----------------|-------------------------|---------------------|------------------|----------------------|--------------------|------------------------|
| July ..  | ..                      | ..                 | 204                  | 27              | 18                      | ..                  | ..               | ..                   | ..                 | ..                     |
| Aug. ..  | ..                      | 16                 | 292                  | 47              | 53                      | ..                  | ..               | 94                   | 5                  | ..                     |
| Sept. .. | 13                      | 78                 | 135                  | 33              | 21                      | ..                  | ..               | 97                   | 6                  | ..                     |
| Oct. ..  | 2                       | 73                 | 30                   | 66              | ..                      | 45                  | 2                | 91                   | ..                 | 2                      |
| Nov. ..  | ..                      | 72                 | 6                    | 16              | ..                      | 31                  | 2                | 33                   | ..                 | 1                      |
| TOTAL .. | 15                      | 239                | 667                  | 189             | 92                      | 76                  | 4                | 315                  | 11                 | 3                      |

(July, August and September), while only three collections were made in October and two in November.

The harvesting of the crop was made on the 2nd December, 1941, after giving due notice to the owners of the various fields and with their permission. Either the owners or their representatives were present at the harvest. The following officers were also present:—

Dr. A. K. Adhikari, M.B., F.R.S.T.M.&H., assistant malariologist, B. N. Railway.

Mr. P. D. Dixit, M.Sc., paddy specialist, Orissa.

Dr. R. G. Panigrahi, M.B.B.S., D.P.H., malaria officer, Orissa.

In each of the ten fields, a plot measuring exactly 20 feet  $\times$  5 feet 6 inches and situated at least 5 feet from the side 'bunds' was selected and all plants standing within that plot were cut. The cut plants from each plot were made into a bundle to which a slip of paper containing the number of the field was attached. All the ten bundles were then brought to the thrashing floor specially prepared for the purpose, and the bundles representing the first eight fields were separately thrashed. As the fields 9 ('treated') and 10 ('control') were more or less completely damaged by flood, it was considered undesirable to thrash them and include their yields in this experiment, as it would tend to vitiate the results obtained. The paddy obtained from fields 1 to 8 was then weighed separately, with the results shown in table VIII.

TABLE VIII

| 'TREATED' FIELDS |             |          | 'CONTROL' FIELDS |             |          |
|------------------|-------------|----------|------------------|-------------|----------|
| Plot number      | Paddy yield |          | Plot number      | Paddy yield |          |
|                  | Seers*      | Chataks* |                  | Seers*      | Chataks* |
| I                | 4           | 2        | II               | 3           | 15       |
| III              | 4           | 11½      | IV               | 4           | ..       |
| V                | 4           | 7        | VI               | 3           | 12       |
| VII              | 4           | 5½       | VIII             | 2           | 7½       |
| TOTAL            | 17          | 10       | TOTAL            | 14          | 2½       |

\* Sixteen chataks make one seer and forty seers make one maund.

### Discussion

It has been stated that, though the main object of this experiment is to ascertain the effect of sullage stocking of ricefields in the dry season on the anopheline breeding in the next rice-growing season, with special reference to the local vectors, there were incidentally three other objects in view, viz. (a) to indicate a method of sullage disposal suitable to rural areas, (b) to control *C. fatigans* (and with it filariasis) without the use of oil, and (c) to ascertain if this method would increase the rice crop in areas where the fields are not otherwise manured.

As the sullage which is spread on ricefields is regulated so that not more than one inch of depth is obtained, and as that amount of sullage soaks completely into the soil in a maximum period of 4 days, it may be taken to be a suitable method of disposal in rural areas where no other satisfactory method is available or practicable. In any case, this is distinctly better than allowing sullage to accumulate in swamps. If the field is ploughed at least once in a month during the period of 'stocking', it might even become one of the approved methods. If the ryots notice the advantages of such ploughing (which are referred to below), there may be no further need to induce them to do so.

In this method, sullage irrigation is so regulated that the swamps are eliminated, rendering breeding of *C. fatigans* impossible. Control of *C. fatigans* and of filariasis would come well within the range of practical politics, which can be adapted to rural conditions with the minimum amount of supervision.

Regarding controlling malaria by this form of naturalistic measure, it may be said that this experiment has confirmed the previous findings as shown below:—

The first four species listed in tables VI and VII are not carriers. There is evidence to show that *A. culicifacies* is not a carrier in this area (Senior White, 1936; 1937). *A. aconitus* was found in the infective stage at Dhanmandal and Malatipatpur, 60 miles north and 22 miles south of Khurda Road respectively. *A. varuna* has so far been found to be a carrier in Jeypore Hills (Senior White, 1936; 1937), in the Central Provinces (Senior White and Adhikari, 1940), in Chota Nagpur (Senior White and Das, 1938 and Senior White and Appal Narayana 1940) and in Bengal (Iyengar, 1934 and Roy, 1938). *A. pallidus* does not appear to be of any importance as a vector at Khurda Road while *A. tessellatus* is definitely not a carrier. The main carrier of this area is *A. annularis*, which, with a low sporozoite rate of 0.08 per cent, is capable of creating and maintaining hyperendemic conditions by the sheer weight of its numbers (Senior White, Mss. and Sarathy, 1932).

Tables VII and VIII show that, in the 'treated' fields, there is a marked increase of non-carriers like *A. subpictus* and *A. vagus* and a very substantial and significant reduction in carriers like *A. annularis*, *A. aconitus* and *A. varuna*.

The observations of last year relating to *A. barbirostris* and *A. hyrcanus* are not borne out by this year's findings. During this experiment, one larva of *A. barbirostris* and 183 larvæ of *A. hyrcanus* were collected from the 'treated' fields as against 15 and 239 respectively from the 'control' fields. The inference that these two species prefer clean water (Rao, 1941) does not, therefore, hold good.

Table VIII shows that (a) the four 'treated' fields yielded 3 seers and 7½ chataks more

paddy than the four 'control' fields, and that the lowest yield among the 'treated' fields is higher than highest yield among the 'control' fields, which is a significant fact. The increase in the yield of the 'treated' fields over that of a 'control' field is estimated to be over 8½ maunds per acre. It is significant that, among the 'treated' fields, that which was ploughed twice during the dry season, viz, field 3, yielded the highest crop, while one of the 'control' fields (field 4), which was once ploughed, yielded the best crop among such fields.

It can therefore be assumed that addition of crude sullage to ricefields in the dry season improves the crop to a considerable extent.

### Summary

Allowing sullage into ricefields in the dry season once a week without converting them into sullage swamps has the following effects:—

(a) increasing the breeding of non-carrier species like *A. subpictus* and *A. vagus* and greatly decreasing the breeding of carriers like *A. annularis*, *A. aconitus* and *A. varuna*;

(b) disposing of sullage in a manner suitable to rural conditions;

(c) controlling *C. fatigans*, and with it filariasis, without the use of oil; and

(d) improving the rice crop to a considerable extent.

### Acknowledgments

The author is indebted to Mr. R. Senior White, malariologist, and Dr. A. K. Adhikari, assistant malariologist of the Bengal Nagpur Railway, for the guidance and encouragement they gave him throughout the period of this experiment. He is also indebted to Mr. P. D. Dixit, paddy specialist of Orissa, and Dr. R. G. Panigrahi, malaria officer, Orissa, for their co-operation, advice and supervision. He is thankful also to Mr. B. Roy, malaria inspector, and Mr. P. Jaganadha Rao, malaria sub-inspector of the Bengal Nagpur Railway, for their co-operation and assistance.

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## A Mirror of Hospital Practice

### CASE OF PITYRIASIS ROSEA SHOWING ENLARGEMENT OF THE SUPRATROCHLEAR LYMPHATIC GLANDS

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and

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D. B. (miner's son), aged 13 years, was seen on 27th September, 1941.

He had a pleomorphic rash resembling that of secondary syphilis, the face and hands being affected with the trunk, arms and legs, the ventral surface showing more than the dorsal. There was no sign of a primary chancre or any other lesion characteristic of secondary syphilis.

The supratrochlear lymph glands were palpable and hard and glands were palpable at the posterior triangle of the neck. The liver and spleen were not enlarged and there was nothing abnormal in the total or differential leucocyte count. Kahn's test was negative. The rash started growing bigger. After a few days the lesion started to scale and within a short time the typical collarette was seen. The scales did not show any organisms.

The patient was given the following ointment: Chrysarobin gr. v, Whitfield's ointment ad 5ss, and in about two weeks' time the rash disappeared.

The lymphatic glands also diminished in size and finally could not be palpated easily.

Another case in a fair-skinned person was seen by one of us with the same result. Only in this case the age was 25 years. Here too the lymphatic glands were enlarged and disappeared with the rash. The Kahn's test was negative.

In the book descriptions of pityriasis rosea we do not find any mention of the lymphatic glands, but these two cases seem to show that the lymphatic glands are affected in some way.

### CLINICAL NOTES ON SIX CASES OF PNEUMONIA TREATED IN TIBET AT ALTITUDES VARYING FROM 9,000 TO 13,000 FEET, WITH M.&B. 693

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PNEUMONIA is a serious disease even at sea level, but at high altitudes the danger is greater as the circulatory and respiratory systems are already working at some disadvantage.

A 10-horse-power engine working at a height of 11,000 feet develops only 5 to 6 h.p. Similarly the heart and lungs have to work harder to maintain equilibrium at a height.

Owing to the extreme cold, fatigue and exposure in Tibet, especially while travelling in winter, pneumonia is of more frequent occurrence than in the plains of India. This series of six cases includes one Tibetan, two Europeans, and three Indians.

*Case 1.*—A previously healthy Tibetan woman, aged 25 years. She was seen in Lhasa (11,000 feet) on the

fourth day of her illness, in February 1940. No history of exposure to cold. She had been treated by a Lama but was getting no better, so it was decided to call the European doctor. Her sister had died the year previously from a similar complaint, Lama treatment having failed. On arrival at the house drums were beating and Lamas were chanting prayers outside the sick-room. The first procedure on any visit in Lhasa, professional or otherwise, is that the guest partake of tea and biscuits, usually in the shrine-room. The patient, puffing and blowing, made her appearance at another table and it was with some difficulty that she was persuaded to go back to bed immediately.

*Examination.*—Patient obviously very ill and cyanosed, with sordes.

Temperature 102.5°F., pulse 120, and respiration 34 per minute. The patient's chest was covered with stamp-marks, put on by the Lama doctor; especially over the right base where she had pain on coughing. There was diminished movement of the right base with early signs of consolidation. The sputum was viscid and purulent with an occasional rusty patch.

*Diagnosis.*—Right lobar pneumonia. M.&B. 693 was administered and the patient made an uneventful recovery.

*Case 2.*—A European, aged 41, resident in Lhasa for four years. He had been in the army previously with no history of illness other than scarlet fever and malaria. He had smoked and inhaled 50 to 60 cigarettes daily for many years. He was also overweight and six months previous to his illness had taken a proprietary drug to try to reduce. It was at this time that he developed precordial pain after exertion; but on examination of the heart nothing abnormal was discovered. He stopped taking the medicine and the pains ceased.

The patient was first seen on the third day of the illness, the history being that he had ridden twenty-eight miles in one day, mid-winter January 1941. On arrival home he felt 'out-of-sorts' and went to bed. He vomited once, and next day was able to sit in a chair.

*Examination.*—The patient did not look seriously ill.

Temperature 99.2°F., pulse 120, and respiration 28 per minute. The high pulse rate suggested that something was radically wrong. On account of the previous history of precordial pain and distress on exertion, it was thought to be a case of heart failure. There was no swelling of the feet, no albumin in the urine and there were no definite signs of heart or lung involvement. There was nothing abnormal discovered about the abdomen. The condition of the patient steadily deteriorated. On the fifth day he brought up a small amount of blood-stained sputum. There was a pronounced cough and he complained of pain at the right base posteriorly and over the precordial area.

Temperature 99.8°F., pulse 120, and respiration 32. Mouth dry; tongue furred; naso-pharynx ulcerated with pus present; heart normal; lungs diminished breath sounds at the right base; percussion note not markedly diminished.

*Diagnosis.*—Right lobar pneumonia. M.&B. 693 was commenced and continuous oxygen inhalations were administered. On the seventh day the patient's condition was critical. The temperature rose to 101.4°F., pulse 120, and respiration 40. There were now definite signs of consolidation at the right base. The treatment was continued. The patient had a crisis that night. Next morning his condition was as follows:—

Temperature 98.4°F., pulse 120, and respiration 28. M.&B. was stopped on the ninth day as the patient was experiencing severe nausea.

*Tenth day.*—Patient's temperature rose to 100.6°F. in the evening with a pulse rate of 112 and respirations 32. There was pain in the right axilla and in the right nipple region with dullness. M.&B. was recommenced.

The right base remained dull to percussion and there was no air entry. The patient refused needling. However, as the temperature remained raised, with raised pulse and respiration rates, a diagnosis of empyema or delayed resolution of the lung was made.

M.&B. was continued at a dosage of 6 to 8 tablets per day when there was fever.

**Subsequent course of the illness.**—Ten weeks after the beginning of the illness the patient was able to get out of bed. His temperature and rate of respiration had settled to normal, but his pulse rate was still in the vicinity of 100; he had lost 56 pounds in weight. He gradually gained weight and was able to get about with the aid of crutches.

A total of 98 tablets of M.&B. (each 0.5 gm.) had been given, i.e., 49 gm.

Seven months after this illness the patient was still unfit. He complained of breathlessness with cough and pain in the chest. He was advised to proceed to India for x-ray of chest, further investigation and treatment.

**In India.**—X-ray of his chest revealed a shadow behind and to the right of the sternum. It was uncertain whether it was an aneurysm of the ascending aorta (his Wassermann reaction was negative), or a neoplasm, and, to ascertain what the condition was, a course of deep x-ray therapy was given. The case is still under observation.

**Case 3.**—A European, aged 29 years, a non-smoker and a total abstainer.

**History.**—Five days ago, he was exposed to cold winds and snowy weather while travelling at an altitude of 14,000 to 15,000 feet. Two days ago he felt 'out of sorts' with a cough and cold in the head, but continued to travel. One day ago he vomited his breakfast, and, though not feeling well, managed to travel to Gyantse (13,000 feet), where he went to bed. He was first seen the next afternoon, i.e., on the third day of the illness.

**Examination.**—Patient looked ill and had a hacking cough. His face was flushed, mucous membranes blue, and throat congested.

Temperature 102.8°F., pulse 110, and respiration 24.

**Heart.**—Nothing abnormal.

**Lungs.**—Slight dullness over the right air entry.

**Sputum.**—Small amount and blood-stained.

**Abdomen.**—Nothing abnormal.

**Diagnosis.**—Early lobar pneumonia.

**Treatment.**—M.&B. 4 tablets at 4 p.m., and repeated at 8 p.m. Morphia  $\frac{1}{4}$  gr. at bedtime.

He slept fairly well that night and the next day his condition had improved. Temperature 99°F., pulse 96, and respiration 21. M.&B. was reduced to 2 tablets twice daily.

On the third day after commencing the M.&B. his temperature touched normal, and on the fifth day he was able to get up. A total of 8.5 gm. of M.&B. was given and he made an uneventful recovery.

**Case 4.**—A sepoy, aged 40, at Gyantse in March 1941. There was no history of previous illness or of exposure to cold. He complained of fever with rigors, and stated that he had vomited twice before admission to hospital.

**Examination.**—Patient did not look markedly ill, tongue furred, mucous membranes somewhat cyanosed. He had a slight cough and was bringing up mucopurulent sputum with streaky blood-stained patches, not typically rusty. His throat was congested. Temperature 99.2°F., pulse 84, and respiration 24.

**Heart.**—Normal.

**Lungs.**—A few crepitations were heard at both bases but more marked on the right. No dullness.

This case was thought to be a very early pneumonia, seen on the first day of the disease, and M.&B. was given straightaway.

The temperature had settled on the third day, but the respiration rate remained raised until the sixth day when the patient was allowed up. He still had a cough and a small amount of sputum, but otherwise made an uneventful recovery.

**Case 5.**—A sepoy, aged 38. He gave a history of having had a cough for two days and fever of 12 hours' duration.

**Examination.**—Patient looked ill, breathing rapidly and coughing.

Temperature 100.2°F., pulse 96, and respiration 30.

**Heart.**—Normal.

**Lungs.**—Movements equal. The percussion note was diminished at both bases. Vocal fremitus was increased at the left base. Air entry was poor and the breath sounds weak at both bases with moist râles. Sputum purulent but not blood-stained.

**Treatment.**—Fourteen tablets of M.&B. were given over 3 days, and the patient was able to get up on the fifth day.

**Case 6.**—A sweeper, aged 19, at Yatung, Tibet (9,000 feet), in September 1941.

The patient accompanied a party from India and came up inadequately clad in a cotton *dhuti* and a thin cotton coat. He first felt ill 4 days previously with cough, fever and vomiting. Next day, the party, with the sweeper, crossed the Jelap La Pass (15,500 feet), and ran into a cold wind and sleet.

The patient was first seen after having been ill 4 days with cough and continuous fever.

**Examination.**—Patient looked ill and cyanosed; tongue and lips dry, grunting respiration, throat congested.

Temperature 101°F., pulse 140, and respiration 40.

**Heart.**—Normal.

**Lungs.**—Slight dullness on percussion over the right base; air entry diminished; no adventitious sounds detected.

**Abdomen.**—Spleen enlarged to a width of three fingers below the costal margin.

**Diagnosis.**—Right lobar pneumonia.

**Treatment.**—M.&B. was commenced at once, and a total of 19 gm. was given in 6 days.

**Course.**—The temperature settled on the fourth day of treatment, i.e., on the eighth day of the disease. On the eleventh day after treatment was commenced the patient left for India, and was fit enough to do the journey across the Nathu La Pass (14,300 feet).

### Summary

1. These six cases of pneumonia diagnosed clinically were treated successfully with M.&B. 693 at these high altitudes. Oxygen was administered in one case only.

2. The second case is of interest on account of the difficulty in early diagnosis, the prolonged course of M.&B. given, and the subsequent x-ray findings in India where the right base showed no signs of disease.

3. Cases 4 and 5 occurred in sepoys and were seen within 24 hours of the onset of the disease. There were few signs of pneumonia and no consolidation, but M.&B. was given early in small doses with very favourable results.

4. Early diagnosis and treatment cut short the course of the illness and only small doses of M.&B. are required. Cases seen and diagnosed after the fourth day of illness are much more severe, and consequently necessitate the administration of larger doses of M.&B.

### INTERCOSTAL HERPES ZOSTER TREATED WITH DIPHTHERIA ANTI-TOXIC SERUM

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**History.**—A railway guard noticed one or two vesicles which he described as blisters and a hyperemic zone near the linea alba over the epigastrium. There



was no subjective symptom at this stage. Next day there were more vesicles and an increasing red zone along 8th and 9th intercostal nerves on the right side, extending up to the axillary border. This day there was a feeling of discomfort but he did not worry much, thinking it to be 'spider lick', and he carried on his work. Next day the vesicles and the surrounding hyperæmic area reached the spine and the entire area became so sensitive that he had to discard clothing and report sick. He was slightly feverish. There was just a slight burning sensation at this stage which later increased to agonizing proportions giving him no rest for the next 4 days and nights. He ran a slight temperature (99 to 100°F.) during this period. A few vesicles ruptured accidentally, the patient experiencing great pain. He became so worried with this experience that he sat up day and night so that the vesicles might not get ruptured.

**Treatment.**—Treatment started on the third day of sickness. Dusting powder (zinc oxide, starch and camphor) to dust over the area and A.P. powder (aspirin, phenacetin) and a plain fever mixture were ordered.

Next day a typical picture of herpes zoster presented itself. Dusting powder, A.P. powders and fever mixtures were given and pituitrin 1 c.cm. was injected.

**Fifth day.**—The same powders, fever mixtures and pituitrin 1 c.cm.; again no relief.

Dusting powder was substituted by *chameli* oil with camphor in it by the patient. He tolerated this oil better than dusting powder.

**Sixth day.**—Same treatment. No relief.

Morphine gr.  $\frac{1}{4}$  and atropine gr. 1/100. Injection given which gave relief for the night.

**Seventh day.**—He felt quite well up to 9 a.m. in the morning but the distress returned afterwards and he was the same again in the afternoon. At 5 p.m. I gave him a subcutaneous injection of 5,000 units of diphtheria anti-toxin.

**Eighth day.**—I saw him in the morning. He was completely relieved. Relief of burning sensation started at about 9 p.m. and by the early hours of the morning the agonizing sensation had entirely left. The burning sensation completely disappeared though some areas over the affected region remained hypersensitive for another three weeks.

**Conclusion.**—The course of this case suggests that diphtheria anti-toxic serum was responsible for the gratifying result. In the *Medical Annual*, 1939, Sir Stewart Duke-Elders mentioned this treatment for intractable herpes ophthalmicus, so I tried it in this case.

My thanks are due to my chief for permission to publish this note.

## B. COLI INFECTION SUCCESSFULLY TREATED WITH M.&B. 693

By S. K. SARKAR, M.B., B.S.

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ON the 3rd day of her confinement, a woman was attacked with fever (103.6°F.) with severe ague. A blood slide for malaria parasites was taken and quinine and alkaline mixtures were given. Next morning she felt better and the temperature came down to 100°F. The same night the high temperature (104°F.) returned with ague. Oral quinine and alkaline mixtures were given for three days without any improvement in the condition. As the oral quinine was having no effect, 2 quinine injections were given at a 12-hour interval (injection of gr. x in 2 c.cm. each time) but still without any impression on the temperature which continued high (102°F. to 104°F.). Chilly sensation was always present. The pulse rate was persistently high (ranging from 150 to 160). Toxæmia was moderate. Treatment

with quinine was stopped. Blood and urine were collected for cultural diagnosis and sent to the railway laboratory at Khargpur. Sulphanilamide tablets and alkaline mixtures were started at the same time. Sulphanilamide tablets were given according to this dosage scheme (0.5 gm. tablets):—

|   | Total   |
|---|---------|
| 1st day—2 tabs. every 4 hours (4 times a day) | 8 tabs. |
| 2nd day—Same dosage                           | .. 8 "  |
| 3rd day—2 tabs. every 4 hours, <i>t.d.s.</i>  | .. 6 "  |
| 4th day—1 tab. every 4 hours (4 times a day)  | 4 "     |
| 5th day—Same dosage                           | .. 4 "  |

Patient's condition remained the same with high temperature, high pulse rate and severe toxæmia. Sulphanilamide tablets were now replaced by M.&B. 693 tablets according to the following dosage:—

|   | Total   |
|---|---------|
| 1st day—2 tabs. every 4 hours (4 times a day) | 8 tabs. |
| 2nd day—Same dosage                           | .. 8 "  |
| 3rd day—2 tabs. every 4 hours (3 times a day) | 6 "     |
| 4th day—Same dosage                           | .. 6 "  |
| 5th day—1 tab. every 4 hours (4 times a day)  | 4 "     |
| 6th day—Same dosage                           | .. 4 "  |
| 7th day—1 tab. every 4 hours, <i>t.d.s.</i>   | .. 3 "  |
| 8th day—Same dosage                           | .. 3 "  |

From the 3rd day of M.&B. therapy, a change for the better was noticeable. Patient felt more comfortable and temperature was lower (99.4° to 101°F.). Pulse rate was still high (110 per minute). The temperature thereafter gradually came down to normal and the patient felt better, though the pulse rate persisted between 100 and 110 for about a month after the temperature and other conditions subsided.

But for a quinine abscess which developed during convalescence and was opened, she made an uninterrupted recovery. I thought that the pus might contain *B. coli*, the organism grown in blood culture, but culture of pus showed *Staphylococcus aureus*.

Below are the results of various examinations done in this connection by the pathologist at Kharagpur:—

Blood slide for malarial parasites. None seen.

Blood culture .. *B. coli*.

Urine culture .. *B. alkaligenes* (due to contamination) urinary symptoms were absent. Routine examination showed albumin (traces) which was probably due to high fever.

No malarial parasites were seen at any time. Differential count on different days of sulphanilamide and M.&B. administration.

|                        | Total leucocytes | Polymorpho-nuclears, per cent | Lymphocytes, per cent |
|------------------------|------------------|-------------------------------|-----------------------|
| Before treatment.      | 20,000           | 96                            | 4                     |
| 7th day of treatment.  | 30,000           | 91                            | 9                     |
| 12th day of treatment. | 15,000           | 75                            | 24                    |

Culture of pus from abscess—*Staphylococcus aureus*.

My thanks are due to Dr. M. N. Sen Gupta, the railway pathologist, for doing the various examinations.

I am grateful to my chief for permission to publish this note.

# Indian Medical Gazette

APRIL

## TRICHINELLIASIS

ELSEWHERE in this number is a recording of *Trichinella spiralis* in a cat in Calcutta. After searching through the *Indian Medical Gazette* from volume I, published in 1865, to the present time we can find no reference to this worm as a parasite of man in India. Baylis in volume II of the 'Nematoda', *Fauna of British India* series published in 1939, gives no definite records of the presence of this worm in the country, but he says it appears to have occurred formerly in man in India, but that no recent references to it have been found in the literature. 'Recent' is an indefinite word but we venture to suggest that, if it were known in man in India, it is surprising that no reference to trichinella has appeared in India's principal medical journal throughout its regular monthly publication for the last seventy-six years.

The distribution of this worm is a wide one; it is therefore strange that it has not been definitely recorded in India before and one feels that Baylis, although he gives no authority, is probably correct in saying that it has been found in India, but if we accept this it is even more strange that it has not been found in the last three-quarters of a century, a period that has been marked by enormous progress in our knowledge of parasites and in the application of many improved methods for discovering them. The explanation of this apparent failure to note the worm is clearly not to be found in the general adoption of better methods of prevention, because worm infections are still rife in this country in spite of the enormous amount of work that has been done on the question of control of those species whose presence is well known, and in the case of this unrecognized parasite, against which no special precautions have been taken, the chances of its eradication or reduction would be much more remote.

The finding of trichinella in a single cat is not a direct menace to man, but it is of importance as it is the first authentic evidence that the worm exists in India, and accordingly its presence in man may be eventually established. It appears to be able to exist in any carnivorous animal and transmission from animal to animal is direct and simple; muscle (meat) containing encysted larvæ is swallowed, the larvæ escape from their cysts by digestion of the wall; they develop into adults in the small intestine, and the females invade the gut wall and produce larvæ which pass all over the body in the circulation and come to rest in muscles, where they encyst, to await the chance of being eaten by another animal and thus continue

their cycle. This absence of host specificity indicates the practical impossibility of eradicating the parasite from any country because the complete cycle can go on continuously in the lower animals (cats, dogs, rats, pigs, etc.) and it only reaches man by way of pork which is the only meat from flesh-eating mammals eaten by him, except that certain primitive races eat cats, dogs and any other small mammals they can capture.

The restriction to the possibility of human infection to eating pork is a natural preventive to the large proportion of the inhabitants of India who will not eat pork, but this caste rule is not a sufficient bar to the propagation of worm infection to explain the absence or at best the extreme rarity of trichinelliasis. This is clear from the fact that *Tænia solium* occurs in India and is probably very much commoner than the records of its occurrence indicate; this worm, also acquired only by the eating of pork, depends on man for the continuance of its cycle, so it should be easy to eradicate in comparison with *Trichinella spiralis* which can continue its existence in many other animals without the intervention of man.

The history of trichinelliasis is interesting to us and we give below a brief outline as it shows that recognition of the disease and the adoption of the most strenuous measures possible in countries with highly developed public health services has not resulted in its disappearance, so that if this worm became firmly established in India it would probably present a serious problem.

The worm was first found in the encysted larval stage at post-mortem examinations in England in 1828; this observation was repeated several times in the next six or seven years and was soon followed by similar reports from Germany, Denmark and North America. The first record in pigs was in America in 1846, and the life history was worked out, partly by Leuckart and partly by Virchow, from 1855 to 1859, and in the following year Zenker showed that trichinelliasis could be a serious disease. The detailed work was done in Germany and the result was that the Germans made strenuous efforts to control the disease but only with partial success, because it is still prevalent there. Although not often seen in England, trichinelliasis smoulders there; only last year several cases were reported from a focus near Wolverhampton, and in the *British Medical Journal* of 27th December last there is an account of another outbreak in Birmingham in which 78 cases were reported. For the past fifty years the problem has received constant attention in the United States of America and numerous tables of statistics from the results of post-mortem examinations for this worm have been published; these have been amplified by specific dermal and precipitin reactions on living persons in recent years. These reports come from all over the Union and on the whole the condition

appears to be more severe in the northern than in the southern states.

Trichinelliasis is now known to be present in many other European countries than the original Germany and Denmark, it is present but not common in parts of Africa and South America, but it does not appear to have been found anywhere in Asia (with the doubtful exception of India), the Pacific Islands or Australia. In this distribution there is a suggestion that it is commoner in the temperate zones than in the tropics.

The symptoms of this disease are not in any way characteristic and they vary in intensity directly with the number of larvæ in the body. It is accepted by those with the most extensive experience that the majority of cases are so mild as to pass unnoticed, or if they are a little more severe they are usually diagnosed as influenza or one of the other short acute fevers, and the most severe infections present the symptoms of one of the exanthemata or of enteric fever, and it is only if the cause is suspected that a correct diagnosis is made; even then it is a matter of considerable difficulty. The search for larvæ at *post-mortem* examinations also requires special examination of the muscles, particularly the diaphragm, either by direct microscopic examination of 'press preparations' or by peptic digestion and extraction of the freed larvæ.

From these remarks it is abundantly clear that trichinelliasis may be present for years in a country without its presence being suspected. This applies with particular emphasis to India because a large part of the rural population is far out of touch with medical aid, so that except for the commonest diseases little is known about

the causes of their morbidity and mortality, and it is particularly applicable to diseases acquired from pigs because isolated primitive communities are among the chief pig breeders in this country.

Man can become infected only by eating raw or insufficiently cooked pork that harbours the larvæ, so at first sight it appears that it would be a simple matter to eradicate the disease, but in practice this has not been found possible, even in such a highly developed country as the United States. The reason for this is that a much more detailed examination of the carcasses is needed to discover light infections than is possible, when the cost in the time of highly skilled inspectors and the amount of damage that the meat must be subjected to is set in the balance against the value of finding every lightly infected pig carcass. A much more effective method has been found in enforcing that all pigs should be fed with only thoroughly cooked food, thus obviating completely the chance of infection.

It is not meant to indicate by this editorial that trichinelliasis is at present an urgent problem in India, nor is it one that is likely to become urgent in the near future, but the discovery of the larvæ in an animal here suggests the possibility of *T. spiralis* being found in human beings as well and this should be borne in mind, because in many of the reported outbreaks the first one or two cases have been quickly followed by a number of severe infections with a mortality as high as 30 per cent, and it is only after the cause has been recognized and care in the consumption of pork advised or enforced that such an epidemic has been brought under control.

P. A. M.

## Special Articles

### ALCOHOLIC BEVERAGES IN INDIA

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#### PART I

THE use of intoxicating drinks, or beverages, by man dates from time immemorial. Modern researches have established that the ancient Babylonians prepared alcoholic beverages from different kinds of cereals as early as 4,000 B.C. The ancient Egyptians and the Babylonian bakers and brewers prepared bread and beer from barley. In Egypt the use of beverages,

made from cereals, was fairly common and was intimately connected with the sacrificial rites practised in those days. The Egyptians taught the art of brewing to the Jews and the Greeks, and the latter transmitted their knowledge to the Romans. There is evidence to show that the Romans made ample use of this knowledge, as beer was served as a ration to the armies in the time of Julius Caesar. The beers of early days were flavoured with wormseed, ground-ivy, pine, willow-bark, etc.; hops came into use very much later.

The scientific study of alcoholism dates from the middle of 19th century A.D. The chief sources of our information regarding earlier times are the writings of poets, especially the gnostic writers, such as theologians, satirists, including Horace, Juvenal, Martial, Lucan and the Greek anthology philosophers, such as Plato, Plutarch and Seneca, and above all the two encyclopædic writers, Pliny the elder and Athenæus. Pliny (A.D. 23-79) consistently decried the luxury and corruption of the age; Athenæus, who flourished at the

end of the second and the beginning of the third century A.D., is of special interest to the medical reader. Aristotle and his disciples, Theophrastus and Chameleon of Heraclea, frequently refer to the use of alcoholic drinks at banquets among the Greeks and Romans, as a sign of barbarism. Both in Greece and Italy, festivals connected with the god of wine served as an excuse for widespread intoxication. Such festivals were subsequently banned by the Roman State. Iberians, Celts and Macedonians were also notorious for drunkenness.

The English word alcohol is of semitic origin, 'Al' and 'Kohl' meaning a fine black powder—the name originally given to the sulphide of antimony, which was obtained by sublimating galena. This powder was used by women as a cosmetic for the eyebrows. Later the distillate of wine was given the name alcohol. In Spain the word 'alcohol' still means either a pigment or a drink. In the Hebrew Bible there is a reference to drunkenness of Noah in the book of Genesis. This reference is believed to be as old as 4,000 B.C.

Though there is some evidence of the existence of a certain amount of individual chronic alcoholism, as mentioned by Pliny and Seneca in classical antiquity, it was mainly of a convivial character, and was limited only to alcoholism associated with prostitution. It differed from that of the present-day alcoholism in the fact that it was more common among the upper classes. There was no legislative control and no distilled liquors were used. The latter were introduced only in the 15th century A.D.

In India the earliest reference to the use of alcoholic drinks is traceable to 2,000 B.C. The ancient Aryan invaders of India, who appear to have been well versed in the art of brewing, used a beverage called *soma*. The exact nature of the *soma* of the Vedic period is still wrapped in mystery and the juice of about a dozen different plants has been regarded as the *soma* of Sanskrit literature. Hemp and ephedra figure in this list. According to Professor Max Muller *soma* was probably a kind of fermented liquor. The *soma* or *homa* plant (*Sarcostemma*) was imported into India by the Mongolian Tartar races. When properly squeezed, it yields a juice, which after fermentation and mixing with honey produces an exhilarating and intoxicating drink. Three kinds of drinks were known in the time of Manu, viz, *gouri* prepared from molasses, *madur* from the sweet flowers of *Bassia latifolia* and *paishiti* from rice and barley cakes. Of these, *paishiti* was reckoned as the most common. The *suras* were included under the generic term *madya*, which included every kind of alcoholic drink. *Jagla*, a kind of rice beer, is mentioned in 'Susruta'—a Sanskrit medical treatise written in the 5th century A.D. *Khola*, another beverage, mentioned in the later editions of the same treatise, was prepared from powdered barley. It is probable that the English alcohol and the Arabic alcohol have the same origin as *khola*. It would appear, therefore, that the art of fermenting starchy and saccharoid substances was understood and practised in India from very early times. In all probability the aboriginal races of India learnt the art of brewing from the Aryan invaders, since from immemorial times they have been preparing and using such beverages.

Certain drinks and beverages commonly used in many parts of the Himalayas appear to be similar to those commonly used by the Mongolian races. Some of these preparations resemble *shamshu* and *saké* used in China and Japan. The reason for this is not far to seek. The Mongolian stock invaded India from the north-east by degrees, and the evidence of this invasion still exists in the Mongolian characteristics of the Himalayan races at the present day.

Apart from the use of alcohol as an intoxicant the ancients seem also to have put it to, what one would call, its legitimate or medicinal use. The word 'whisky' is derived from *usquebaugh* (Gaelic) which means water of life. The nectar of Indian deities referred to as *soma* is also alleged to have been an alcoholic drink by some authorities. Finally, alcohol is believed to have been the first hypnotic and anæsthetic used by

man for relieving pain, while spirits are still used in many places as a universal remedy for practically all diseases.

### Classification of the alcoholic beverages used in India

The excise law has adopted a somewhat artificial distinction between the alcoholic drinks used in this country, viz, country liquor and foreign liquor.

**Country liquors.**—These are the plain spirits made from approved bases and taxed at the local excise rate; they also include the fermented liquors prepared according to indigenous processes.

**Foreign liquors** include all imported liquors and those manufactured in India in imitation of the imported liquors. These are taxed at a tariff rate. They also include spirits made from materials other than those recognized as bases for country spirits and all other kinds of sophisticated and flavoured spirits made from special bases. Thus all the spirits manufactured in India even after the European method, when plain, are classed as country spirits, but when they are sophisticated, they are classed as foreign liquor.

The alcoholic beverages can best be divided into fermented and distilled liquors.

**Fermented liquor.**—The fermented liquors that are used in this country can be further divided into two groups:—

(a) Natural products such as 'toddy' which include the juices of various kinds of palm trees.

(b) The locally manufactured drinks which are produced by fermenting different bases such as rice, millet, toddy, etc.

**Distilled liquor.**—The manufacture of country spirit in India is allowed from a few specified bases only. The ideal materials for fermentation are malt, barley and sugar which can be obtained from various sources. Starches are freely used for commercial and economic reasons. The more frequent substitutes are rice, potato, tubers, sugarcane, mahua flowers and cashew fruit.

(i) **Spirits made from sugars.**—For the manufacture of alcohol, sugars are used chiefly in Northern India, particularly in the Punjab, the N.-W. Frontier Province and Sind. The common sugars used for this purpose are the cane juice or *ras*, refuse of crushed sugarcane 'megass' which is termed *pata*, the raw sugar known as *jaggri* or *jaggery*, also *gur*, *rab*, i.e. the semi-solid *gur*, molasses and treacle.

(ii) **Mahua spirits.**—Mahua, also known as *mohwa* or *mohwa* (*Bassia latifolia*), is the next commonest base employed for the manufacture of country spirit in India. The *mahua* grows wild in Central India, western districts of Bengal, the United Provinces, Gujarat, Kanara and Assam. The plant is capable of growing at altitudes up to 4,000 feet above sea level, and is often cultivated for its flowers. The flowers are rich in sugar and are collected in the months of February to May. A tree yields approximately 160 to 230 lb. of flowers, which are dried in the sun till they turn reddish brown and give out a peculiar mousy odour. When kept for some time, they change to black and become moist as partial fermentation sets in of itself during storage.

(iii) **Rice spirits.**—Rice spirit was at one time a popular drink in Bengal. The use of rice for the manufacture of spirit is at present discouraged as it involves a considerable wastage of food material.

(iv) **Toddy spirits.**—Toddy is sometimes used for distilling spirit in Bombay and Madras presidencies.

(v) **Fruit spirits.**—Fruits such as raisins, dates and apples were used in the past in Sindh and Kashmir; at

present, however, they are rarely employed for this purpose.

(vi) *Cashew spirits*.—In South India, especially in South Kanara, spirits are sometimes distilled from cashew fruit (*Anacardium occidentale*), which is popularly believed to have diuretic and diaphoretic properties. It is also said to possess analgesic effects when applied externally to inflamed joints, as it contains small proportions of the active principles of the cashew, viz, cardol which has irritant properties and anacardic acid, which is an active compound. Because of the presence of these substances, its use should be discouraged.

(vii) *Spirits from cereals*.—Cereals, such as wheat, rye, barley and oats, are also used for brewing and distillation.

(viii) *Spirits from uncommon ingredients and adulterants*.—Besides the above recognized bases other substances are sometimes added to the fermenting mass to enhance its effects, the most common being *datura* or Indian hemp; strychnine or nux-vomica seeds, opium or poppy capsules, aconite, colocynth (bitter apple or *thu*), *Terminalia balarica* or *bhaira* or *sagona*, *Terminalia chebula* fruits or *harrahilika*, *Sorghum vulgare* or *joar* root, *gomyin* (seeds of *Entada scandens* and tobacco). This practice is dangerous and has sometimes led to fatal results.

*Chemistry of alcoholic fermentation and distillation*.—Carbohydrates, such as starch, which form the main constituents of cereals, must be converted into sugar through the process of saccharification or conversion, before they can directly ferment by the action of yeast. This is brought about by the presence of the ferment in the yeast and also by the action of acids under artificially increased pressure and heat. When starch is boiled with dilute acids, water is taken up and it splits into dextrose and dextrin. The rice starch can also be converted into sugar by certain moulds which grow naturally on damp rice. Sometimes these moulds are collected and used in the same manner as brewer's yeast.

Canesugar requires first to be changed into a mixture of fermentable sugars such as dextrose and laevulose. The mixture of dextrose and laevulose, resulting from inversion, is an uncrystallizable syrup; it is even sweeter than canesugar and is called invert sugar or commercially 'invert'. Inversion is affected either through a substance in the yeast called 'invertin', or through the action of dilute acids such as hydrochloric or sulphuric acid. Inversion may take place at ordinary temperature, but it is aided and accelerated by heat.

*Fusel oils*.—When alcoholic fermentation occurs 95 per cent of the sugars are converted into ethyl alcohol. Five per cent are converted into other substances, namely, organic acids, higher alcohols, particularly propyl, butyl, and amyl alcohols and aldehydes and esters. These substances are present in ordinary wines and beers in minute quantities but pass in higher concentrations in pot-still spirit. The volatile substances with higher boiling point than ethyl alcohol are collectively known as *fusel oil* which in freshly distilled spirit impart a nasty taste, but which on storage for years undergo chemical changes and impart to the spirits special flavours. Pot-still whisky contains 0.3 per cent of fusel oil, but with patent stills only 0.03 is left. The higher alcohols are important constituents of fusel oil, amyl alcohol occurring in larger quantities and propyl and butyl in smaller quantities. The higher alcohols are more toxic than ethyl alcohol. Raw spirits produce very deleterious effects and carelessly distilled spirits are extremely toxic. Very little, however, is known regarding the action of constituents of alcoholic beverages other than ethyl alcohol.

Methyl alcohol contained in wood spirits to the extent of 5 to 10 per cent behaves differently from ethyl alcohol inasmuch as it is very slowly oxidized by the tissues. The drinking of wood spirit and methylated spirit is an important cause of poisoning in man on account of the methyl alcohol present in it, the chief symptoms produced are coma lasting for some days,

bilateral inflammation of the optic nerves and retina leading to total blindness.

*Manufacture of country spirits*.—The following five agents are necessary for producing alcoholic fermentation: sugar, water, ferment, heat and air. In the absence of any of these agents fermentation cannot take place.

The material, called the fermentative base, is, after passing through stages of conversion or inversion, if necessary, steeped in hot water for the extraction of its sugar content. This solution of sugars is known as the 'wort'. The 'wort' is cooled to a particular temperature, and the yeast ferment is added to it to start fermentation. This process is called 'setting'. The 'wort'. The yeast should be pure, otherwise there is the danger of other organisms, e.g., the acid-forming organisms contaminating the mass. *En passant* it may be noted that a certain amount of yeast is naturally present in the fermentative bases and the temperature employed in extracting the sugars is not high enough to kill it. On the surface of *mahua* flowers, *gur*, etc., certain kinds of yeast are to be found, which start fermentation as soon as the sugars pass into solution. Therefore the sugary solution rarely exists as a true 'wort', which properly speaking is an unfermented liquid, but technically becomes almost at once a 'wash', i.e., a fermenting or fermented liquid. The common practice is to mix *mahua* flowers with spent wash and water (this stimulates natural fermentation) and to pass the whole wash when fermented, including the solid matter, into the still. This is, however, a wasteful process and results in the production of inferior spirits.

Strong solutions of sugars should not be used as alcoholic fermentation cannot proceed in a wash which contains more than 10 per cent of its bulk of alcohol; so that any sugars that remain in the liquor, after this point is reached, are wasted.

It is necessary to regulate the specific gravity of the wash. The specific gravity of the wash when it is first prepared is known as the first or 'original' gravity to distinguish it from the lower gravities found as fermentation progresses. With some indigenous fermentative bases the first gravity does not entirely represent sugars, or other fermentable substances, and in such cases it is necessary to ascertain the proportion of non-fermentable materials by other tests. For the patent still the most suitable original gravity is 1.045 to 1.105, whilst for a pot-still a somewhat higher original gravity is recommended. Different qualities of *mahua* or *gur*, etc., yield different quantities of sugars in solution, and the resulting specific gravity varies with the quality of the base employed. It is therefore difficult to suggest the number of gallons of water that should be added to a certain amount of the fermentative base. In actual practice, therefore, the most suitable initial gravity for the different kinds of bases, under different conditions, should first be determined; and before adding the fermenting agent to the wash it should also be ascertained whether this gravity has already been attained.

Sometimes such substances as ammonium sulphate and sulphuric acid are added to the wash to accelerate the process of fermentation. Ammonium sulphate is utilized as a nitrogen-containing food by the yeast cells. Sulphuric acid, when added, checks the undue growth of the acid-forming substances, such as acetic and lactic ferments, and thus it indirectly helps the action of the yeast. The bark of the acacia tree, i.e., *kikar* (Tamil, *kurruvelam*), is largely employed in sugar washes for similar purposes in the Punjab and Madras and Bombay presidencies on account of its tannic acid content, which precipitates the albuminous matter in the wash and helps in fermentation. It also prevents excessive acid formation in the wash. *Amla*, the astringent fruit of *Phyllanthus emblica*, is used for a similar purpose in Central India.

The temperature of the wash must be regulated to avoid too high a rise or too low a fall, as in the first case improper fermentation results and in the second case fermentation is arrested. The lowest point at



which fermentation can proceed is 59°F., while 82°F. is the optimum temperature for vigorous fermentation. The proper length of fermentation depends on many conditions, such as the amount of wash, the temperature, quality of the yeast and the fermentative bases used. A badly managed *jaggri* fermentation sometimes extends up to two weeks. Toddy is by far the quickest and most easily fermented of the bases used in Indian distilleries. Crude toddy fermentation is commonly completed in two or three days during summer and in three to five days during winter.

**Colouring and flavouring agents.**—After the completion of fermentation, the mass is passed into stills for the separation of the volatile alcoholic contents from the fermented mass, and the distillate thus obtained is diluted to the necessary strength before it is ready for distribution. Caramel is the common flavouring and colouring agent used in this country for spirits. It is prepared by heating sugar when water is removed and a number of bodies of indefinite composition known as caramel and its derivatives are produced. Caramel or 'burnt sugar' is thus a mixture of several compounds. Among the less commonly used flavouring agents may be mentioned ginger, nutmeg, gum acacia, saffron, keora (*Pandanus odoratissimus*), turmeric, fruit of *Heliotropes isora*, seeds of *Nelumbium speciosum*, a kind of water-lily, catechu, fennel, aniseed, cardamom, coriander, orange, *mundi nim*, peppermint, mango, *khaskhas*, sweet lemon and rose. Night-jasmine flowers (*Harsinghar sheili*) and *tesu* flowers are also rarely added as harmless colouring agents. This list, of course, excludes narcotic adulterants such as *Cannabis indica*, chloral hydrate, medinal, arsenic, dhatura, etc., which are sometimes used.

Besides the country spirits, the methods of manufacture of which have been outlined above, there are two other kinds of distilled liquors used in certain parts of this country. These are :—

(i) *Mandwa spirit* is one of the choicest distilled country liquors used in Jaunsar Bewar on ceremonial occasions and during marriage or other festivities. It is prepared by baking 16 pounds of mandwa flour into a single cake about 1 inch in thickness and 8 inches in diameter. The cake is then broken into small pieces, mixed with the ferment *khemiki roti* and made into a homogeneous mass with 16 pounds of water. This mass is stored in a large earthen vessel and stirred two or three times a day for 10 to 14 days, during which period fermentation sets in. In the winter season the fermentation may take three to four weeks before the mass is ready for distillation.

(ii) *Rakhshi* is a distilled liquor which is used in the Eastern Himalayas, particularly in Nepal and the adjoining areas. It is prepared by distilling the fermented beers used in those parts, e.g., *pachwai* and *margua*. Although distillation is not allowed by law, illicit distillation is carried out fairly extensively in the hills on the borders of Nepal. *Rakhshi*, prepared from fermented rice, is sold by contractors licensed by the Government. This liquor is largely used by the Nepalese section of the population of Darjeeling district and by the higher class Bhūtyas.

### Foreign liquors

The foreign potable spirits used in India can be classed under three categories :—

I. *The genuine and fully matured spirits.*—Genuine mature spirits are solutions of ethyl alcohol in water, containing sufficient quantities of the by-products of fermentation which give them a characteristic odour and taste. If old methods of distillation in pot-stills are adopted, larger quantities of esters, higher alcohols, etc., are left in the spirits and these are responsible for the characteristic flavour and taste. Storage in wooden casks improves the flavour because of

certain changes in the character and amount of these secondary constituents produced through storage. According to the Unmatured Spirits (Restriction) Act of 1915 all plain spirits intended for human consumption must be kept in bond for a period of three years before issue. In practice, most of the good brands of spirits are stored for considerably longer periods than the three years specified by the British and the French excise regulations. This act does not, however, prevent the use of new spirits in the preparation of compound spirits, such as gin, British brandy, etc., provided that certain excise duties are paid. The retail price of these spirits varies per dozen bottles from Rs. 84\* upwards, the longer the storage the higher the price.

II. *Genuine but immature spirits.*—These spirits are genuine in so far as they are made from the same fermentation bases as the genuine and fully-matured spirits. They are generally distilled by means of 'patent stills' and, as a result, an appreciable quantity of the secondary products is left behind, and therefore the long storage process for maturing is not necessary. Quite a large number of such spirits are used in India, such as the various brands of whisky imported from Scotland and brandies from France. They should be regarded as immature spirits as they have not been stored for a reasonable time for maturing. They are sold at a low price of Rs. 40 to Rs. 55 per doz. bottles.

III. *Imitation or fictitious spirits.*—The imitation spirits, also known as artificial spirits, are manufactured by diluting ethyl alcohol (rectified spirit) from which by-products have been removed by means of effective 'patent stills' in such a way that the fermentation base is no longer discernible. Suitable smelling and flavouring agents bearing the odour of genuine spirits are then added to impart the necessary taste and odour to the diluted alcohol. Flavouring agents are usually added in the form of essences such as volatile oils, ethyl nitrite, paraldehyde, acetic acid, acetic ether, almond essence and occasionally traces of hydrocyanic acid, cassia buds, catechuyaris roots, absinthe or wormwood oil and various colouring agents. The basic substances in all the essences are esters peculiar to each spirit, e.g., ethyl butyrate and ethyl nitrate in case of whisky; spirits of nitrous ether and amyl capronate in case of brandy and cognac. Imitation spirits contain smaller quantities of by-products than genuine spirits and have, therefore, a comparatively mild taste.

For the past 20 years the use of such spirits has increased considerably in this country. Many different brands of these imitation spirits simulating whisky, brandy, rum, etc., were imported from Japan, Germany, Holland and other countries. They are sold at a considerably lower price than the genuine spirits; the price being Rs. 30 to Rs. 40 per dozen bottles.

\* All the prices quoted are pre-war.



They owe their cheapness to the cheap fermentation bases such as potatoes, rice, etc., from which they are distilled. On account of their low cost and milder taste they are becoming more and more popular every day.

*Varieties of foreign liquors.*—The foreign liquors may be classed in the following three groups:—

(1) *Fermented liquors (undistilled).*—Wines are obtained by the fermentation of grapes or other fruits. The fruits from which the wine is to be manufactured are reduced to a fine pulp which is allowed to ferment naturally; this fermentation is due to the yeasts naturally present on the skin of the fruit. The fermented liquor is then strained and casked ready for use. If fermentation is allowed to the extent that almost all sugar present is fermented, the resulting wines are termed 'dry wines', but when the process is incomplete and the liquor contains a relatively large amount of unfermented sugar, it is called 'sweet' or 'full-bodied' wine. To prevent further fermentation and to prevent the liquor from turning sour in the tropics, alcohol, usually brandy, is added; this acts as a preservative and the process is called 'fortification'.

Wines are usually named after the places of their manufacture. Thus 'Medoc' is the produce of Medoc in France. 'Sherry' is imported from Xere in Spain; and the name 'Port' is applied to all wines shipped from Oporto. No wines are at present made in British India, though some years back small quantities were made in Kashmir.

(a) *Cider and perry.*—Cider and perry are made from apples and pears, respectively. The consumption of these liquors is small. Some time back some cider was made in Kashmir, but not in any other part of India.

(b) *Malt liquors.*—These are made from malt and hops by steeping specially-prepared or 'malted' grain in water; the solid matter is strained off and the liquid thus obtained is boiled with hops: the hops are next strained off and the strained liquor is fermented by adding specially prepared yeast. After fermentation is complete, the liquid is allowed to settle and is then casked for use. At the present time, glucose and other similar materials are largely used in place of malt, and hop substitutes are occasionally used in place of hops. Malt liquors are used extensively all over India, especially in towns during the hot weather. The malt liquors commonly used in this country are beer, ale, stout and porter.

*Pale ale* is made from the best malt with the addition of an especially large amount of hops.

*Mild ale* contains more alcohol and extract than the above.

*Porter* is a black beer made with specially prepared malt, which gives it its special flavour and colour.

*Stout* is a strong porter.

*Lager beer* is a light beer containing more carbonic acid gas than ordinary beer on account of the distinctive modes of fermentation carried on at low temperatures by special kinds of yeast. It should be stored at low temperatures.

(2) *Distilled foreign spirits.*—They can be distinguished according to British Tariff from enumerated and unenumerated spirits.

*Enumerated spirits* are those which have the distinctive flavour of the substances from which they are made; the common examples being whisky, brandy and gin.

(a) *Whisky* is an alcoholic liquor made by distillation from a fermented mass of cereals treated with malt. It may also include other spirits prepared with the distinctive colour, odour and taste of whisky.

(b) *Brandy* is distilled from grape wine.

(c) *Rum* is the spirit made from various products of sugarcane. Imitation rums are made from bases other than sugarcane and are coloured and flavoured so

as to resemble genuine rum. The spirit made or compounded in India for sale as rum under foreign liquor licenses is, before issue, generally coloured with caramel.

(d) *Gin* is a colourless spirit, sweetened or unsweetened, distilled from grain or other bases such as barley, rye or maize. It is flavoured with juniper berries or other flavouring agents so as to possess the characteristic taste and odour of gin.

*Unenumerated spirits.*—All other imported spirits are classified as enumerated spirits. The most common of the unenumerated spirits of high strengths, made from potatoes and other bases, are used largely for compounding. These are commonly known as 'silent' spirits, inasmuch as they give no indication of their origin.

*Liqueurs, etc.*—These are, as a rule, imported artificially-flavoured spirits. They are compounded with a variety of flavouring, colouring or sweetening agents. The methods of production are usually trade secrets. Many British-made liqueurs are commonly known as 'Cordials'. 'Bitters' are spirits compounded with bitter flavouring agents.

### *Fermented country liquors (country beers)*

Country beers used in India are obtained either directly from plants as saps or juice, or from the cereals through the process of brewing or fermentation.

#### *A. Natural fermented juices*

*Tari*, or toddy as it is sometimes called, is a common beverage in certain parts of India. It consists of the fermented or unfermented sap of different kinds of palm trees. The stems of several palms contain large quantities of starch as reserve food, especially the species which save up for a large terminal inflorescence, e.g., sago palm (*Metrosylon sagu* Rottle) of Malacca, from the pith of which sago is also obtained. In several palms there is a great flow of the sap towards the inflorescence and by tapping the plant large quantities of a sugar-containing fluid are obtained. The palms already tapped as sources of toddy in India are: Palmyra palm\* (*Barassus flabellifer* Linn.), Cocosmucifera, Caryotaurens, wild date palm (*Phoenix sylvestris* Roxb.), Nipa palm or water coco-nut (*Nipa fruticans* Wurmb.), *Arenga wiggle* Goliff, etc. The sap thus collected is known as toddy and when fresh it forms a favourite drink in tropical countries; after fermentation it acquires intoxicating properties. The distillation of the fermented toddy produces a strong spirit known as palm wine or arrack.

*Method of tapping.*—The method employed in extracting the sap of palmyras or coco-nut trees is to cut off the end of one of the flowering shoots and place a collecting-pot underneath it. A fresh slice is cut off every day and the shoot bruised with a wooden hammer or a pair of crushers to draw out the sap. In the case of date palms, a portion of the stem is chopped off and the sap running down is drawn into the pot by a leaf or wooden peg inserted in the incision. Care should be taken in tapping date palms to see that the life of the palm is not endangered by the operation or through the exposure of a soft surface to the ravages of white-ants, crows, rats or squirrels or of the palm

\* Palmyra palms (*Barassus flabellifer*) are cultivated throughout the tropical parts of India, e.g., Bengal, Assam, the Central Provinces, Bombay, Madras, Malabar and in the southern parts of the United Provinces. In most of these places, the plant also grows wild along with coco-nut and date palms, which are also used for making *tari*. Palmyra is prized more for its *tari* in the south than in the north. On the other hand, the juice from wild date palm *Phoenix sylvestris* is more liked in Bengal and Behar than elsewhere. On the Western Coast, in Gujrat and Kathiawar, wild date trees grow abundantly and form the chief source of this drink. *Sagu* and *dadasal* palms are also tapped when other kinds are not available.

weevil *Rhynophorus ferrugineus*, which is the most destructive of all. The actual technique of making an incision varies in different places. In Madras Presidency a horizontal cut is made immediately under the apex of the palm and a triangular section, which grows deeper with each day's tapping, is removed below it. This is sometimes divided into two by a ridge which is left as a support for the apex. In Bombay Presidency a comparatively narrow section passing from below upwards is scooped out to one side of the centre of the stem. In Bengal the incision extends half way round the trunk but it is much shallower than in the Madras or the Bombay presidencies and, unlike the Madras incision, its broadest portion is at the base. Experience shows that the Bengal process is much the least destructive. To prevent the destruction of trees, the following precautions should be observed:—

No incision should be made at any point within four feet of the ground, or one foot from the base of the central whorls, or 18 inches from the top of any incision, and it should not be deeper than one-third of the diameter of the tree. No tree should be tapped oftener than in alternate years and not for more than six months in the year. The tappers should leave not less than eight leaves at the top of the tree in addition to the central whorls springing from the head of the tree.

*Seasons of yield.*—Coco-nut *tari* can generally be obtained all the year round; but the yield of palmyra and date *tari* is limited to a certain season which varies from October to March in the case of date palms, and from April to June in the case of palmyras.

*Quantity of yield.*—The quantity of *tari* yielded by different kinds of trees varies a great deal according to localities. The result of a series of experiments

conducted in Madras has shown that the average annual output of a coco-nut tree is 70 gallons and that of a palmyra or date palm 27 gallons. In Bombay Presidency, observations indicate that a palmyra yields as much as a coco-nut palm and that the average annual yield for either varies from 90 to 111 gallons. Observations carried out in Bengal show an average yield of 43 gallons for male and 57 for female palmyras in their best season, and of 25 to 30 gallons in case of date trees.

#### *Present extent of tari consumption in India.*—

The chief *tari*-consuming areas are most parts of Bombay Presidency, Bengal, certain districts of Behar and Orissa adjoining Bengal, Gorakhpur and Benares divisions, and Farrukhabad district of the United Provinces, the whole of the Madras Presidency except the Nilgiris, Nagpur, Amraoti, Wardha, Chanda districts of the Central Provinces and Berar and Coorg. The consumption varies in different seasons of the year, being greater during the hot summer months than in the winter.

Owing to large variation in the number of trees in different provinces, and the absence of any regular records of the number of trees tapped, it is difficult to make even a rough estimate of the total or comparative consumption. The following figures may, however, serve to give some idea :—

TABLE I

*The present position of tari consumption in different Provinces of India*

| Province                               | Geographical extent of use and tree-tax system  | Revenue in lakhs of rupees | Kind of trees tapped   | Total number of trees tapped | Consumption in bulk gallons |
|--|---|----------------------------|--|------------------------------|-----------------------------|
| Bombay Presidency ..                   | Whole of the Presidency, especially in Surat Thana, island of Bombay-Kolaba district and Panch Mahals.                | 71,15,000                  | Coco-nut, date and palmyra.                                  | 20,646                       | 207,017                     |
| Madras Presidency ..                   | Whole of the Presidency except part of Nilgiri districts and Attapady valley in Malabar and portion of Agency Tracts. | 2,15,37,000                | Coco-nut palms, sagu palms, palmyra, date palms and dadasal. | 2,096,950                    | 7,691,347                   |
| Bengal Presidency ..                   | Throughout the presidency.  | 7,61,000                   | Date palms, palmyra and coco-nut.                            | 998,968                      | Not used                    |
| Central Province and Berar.            | Nagpur, Hasangabad, Bhandara, Jubbulpur, Chanda, Wardha, Nimar and Dangar districts.                                  | 46,47,000                  | Palmyra and date palms.                                      | Not available                | 637,720                     |
| United Provinces ..                    | Basti and Gorakhpur   | 7,86,000                   | Date palms and palmyra.                                      | Do.                          | Not available               |
| Assam ..                               | Goalpara, Kamrup, Nowgong and Lakhimpur districts.  | 7,420                      | Do.  | Do.                          | Do.                         |
| Behar ..                               | Patna, Gaya, Saran, Muzaffarpur, Darbhanga, Monghyr and in Majai portions of the .. districts.                        | 2,496                      | Do.  | Do.                          | Do.                         |
| Orissa ..                              | Ganjam district   | 85,000                     | Date palms   | Do.                          | Do.                         |
| Coorg ..                               | All over  | 83,000                     | Palmyra and dates  | Do.                          | Do.                         |
| Punjab, Delhi and British Baluchistan. | Not used  |                            |  |                              |                             |

**Fresh and fermented juices.**—It is commonly believed that if trees are tapped before sunrise the juice obtained is sweet and agreeable to taste. Fermentation, however, sets in rapidly if it is drawn after sunrise, the juice being converted into an intoxicating drink, toddy or *tari*.

**Fresh tari or sweet tari.**—*Fresh tari* is the name given to *tari* that is freshly drawn; it is popularly supposed to be non-alcoholic and to possess wholesome properties. It is interesting to note that *tari* ferments very readily, partly because the solution is favourable for rapid fermentation and partly on account of the fact that the utensils in which the juice is drawn are almost invariably coated with old ferment. The rate of progress of fermentation varies according to the kind of tree tapped and the temperature. Thus, when the temperature is below 60°F. or when a new or smoked pot is used on a tall tree, or when some chemicals are added to arrest fermentation, the *tari* contains practically no alcohol.

The term *fresh toddy* designates toddy in which nothing has been done to check fermentation and which is consumed just after it is tapped from the tree and before fermentation is far advanced. *Fresh or sweet toddy* is supposed by the Parsees to have medicinal properties, chiefly as a diuretic, and is largely used in Bombay, Surat and in some parts of Assam, Bengal and Madras presidencies.

**Sweet toddy** is the name given to *tari* in which the fermentation has been arrested by the addition of lime. It is used both for drinking and for sugar making, and is especially popular in Madras and Bombay presidencies. The lime may be placed loose in the pot or, preferably, as a thin paste coated over the inside. For all practical purposes unfermented or natural *tari* is very difficult to obtain. The juice which is commonly sold as *fresh tari* shows an average strength of 94% U.P.

**Alcoholic content.**—The alcoholic content of various kinds of *tari* vary according to the variety of the palm tapped, the season of the year, the time at which it has been drawn and other circumstances, such as the presence or absence of lime in the utensils.

The average alcoholic content of different forms of *tari* obtained from different kinds of palms in India is given in table II.

TABLE II.

*Alcoholic strengths of tari from different kinds of palms in Madras Presidency (after Bedford)*

|          |    |    |                            |
|----------|----|----|----------------------------|
| Coco-nut | .. | .. | 85.7 U.P. or 8.1 per cent. |
| Palmyra  | .. | .. | 90.8 U.P. or 5.2 "         |
| Date     | .. | .. | 91.4 U.P. or 4.9 "         |
| Sagu     | .. | .. | 89.6 U.P. or 5.9 "         |

The alcoholic strength of *tari* used in Bengal varies from 92% to 95% U.P. It possesses approximately the same food value as good malt beers sold in this country. Recent inquiries made by the authors show that the juice is preferred in the following order according to the nature of the tree, i.e., coco-nut, palmyra (fresh palm) and date palm.

**Price.**—The retail price of *tari* during the season is 6 pice a gallon in Bengal, Behar and Orissa, but it rises to 4 annas in other parts, such as Eastern Bengal and Assam, where the trees are fewer in number. It varies from 2 to 4 annas per gallon in the United Provinces, where it even goes up to 6 to 8 annas per gallon in special localities. In Madras Presidency the average price ranges from 4 to 5 annas per gallon, except in South Kanara where it is only 2 annas per gallon. In Bombay Presidency different prices are fixed for different areas; in Surat district, where the trees are abundant, it can be had at 6 pice per gallon. In Bombay city, the usual price varies from 3 to 4 annas per gallon. In the Central Provinces the price varies from 6 to 4 annas a gallon.

**Some medicinal uses of tari.**—In addition to its other uses, *tari* is commonly employed as a stimulant and antiphlegmatic. If taken regularly, freshly-drawn *tari*

acts as a good laxative. It is also believed to be useful in inflammatory and dropsical conditions, and is regarded as a nutritive, diuretic, tonic, and a cure for gonorrhœa. A stimulating soft poultice prepared from toddy and rice-flour is regarded as a valuable stimulant application for gangrenous, indolent ulcers, carbuncles, etc. The unfermented juice is very often taken in early mornings, and is supposed to aid digestion and increase the weight. The fresh juice is regarded as a stimulant and antiphlegmatic by the indigenous *hakims* and *vaid*s. Slightly fermented juice is used in diabetes. The fermented juice acts as a purgative.

Mention may be made here of the utility of the indigenous toddy in India. Toddy has been a blessing in the tropics for the prevention of beri-beri or hypovitaminosis. As the sunlight and fresh air make good the deficiency of vitamin D in all ill-nourished inhabitants of slum areas, toddy very often makes good the vitamin-B deficiency caused by the consumption of milled and polished rice. The nutritive qualities and vitamin content of the beverage probably compensate for its harmful alcoholic content. It has been observed by the present authors that in areas where the use of toddy is prevalent, deficiency diseases caused by vitamin B deficiency are rare. Epidemics of polyneuritis, anæmia, beri-beri and certain varieties of dermatitis are quite common in localities where these beverages are not used.

#### B. Artificially fermented country beers

The fermented country beers used in India are brewed from rice, barley, millet and sometimes from *gur* or *mahua*. They are known by different names in different parts of India. In table III are summarized the vernacular names of these beverages, the cereals from which they are brewed and the localities in which they are used.

TABLE III

| Vernacular names of beers and the materials used for their brewing                          | Localities in which used   |
|---|--|
| 1. <i>Sur, lugri, chang</i> (from mandwa and rice).   | Kangra district, Lahoul and Spiti valley in the Punjab and Kashmir.                              |
| 2. <i>Chami</i> (from rice and millet).   | Kashmir.   |
| 3. <i>Rabra, soma, pakh-wai, boja, darbakra</i> (from rice and millet).                     | Jaunsar taluk of Dehra Dun district in U. P. and Bhutya taluk of Kumaon division.                |
| 4. <i>Pachwai, mandia, marua, jaur, chanua, nigar, kusha, sugda</i> (from rice and millet). | In the western districts of Bengal, Behar and Orissa, Bhutan, Sikkim and eastern parts of Nepal. |
| 5. <i>Madh, zu, laopani</i> (from rice).  | Assam, Nagas, Sadiya Frontier Tract and Tibeto-Burman tribes.                                    |
| 6. <i>Boja, londs, sonti soru</i> (from millet).  | Bombay, particularly Maharashtra, and in the Madras Presidency.                                  |
| 7. <i>Akki, bhoja</i> (from rice and millet).   | Mysore plateau.  |
| 8. <i>Congee</i> (from rice and millet).  | Used in Burma by Khyen and Karens.   |

### C. Method of manufacturing Pachwai and other common country beers

Two essentials required for the manufacture of these beers are: (1) fermenting material and (2) cereal to ferment.

#### 1. Fermenting material

This is generally supplied in the form of cakes of coarsely-ground corn permeated with dry and empty mycelial filaments of *Mucor*, bearing numerous reproductive bodies in the form of chlamydospores. It also contains a certain proportion of the root tissue of a species of *Polygala* which secures in them the presence of a number of reproductive fungal elements capable of retaining their vitality for prolonged periods, if kept dry. The proportion of *Polygala* in the cakes has to be carefully regulated as an undue proportion may lead to suppression of growth of the fungal elements. On the other hand, any defect may fail to suppress the common and useless fructification of the fungus. It is interesting to visualize how such difficult formulæ of these cakes have been worked out by the uncivilized or semi-civilized tribes, who resort to the use of these beers. These ferments are manufactured and sold throughout the whole length and breadth of the Himalayas and are sometimes imported from Tibet. In places where the use of these drinks is very prevalent, the ferments are prepared locally under different names by certain tribes, and the secrets of their composition are carefully guarded. In their preparation a large number of essential elements are mixed with a number of others which are not only unnecessary for fermenting processes, but, as is explained further on, are sometimes poisonous and extremely dangerous to health. The most important of these are described below:—

(a) *Bakhar*.—This is the most widely used of all the ferment materials in the manufacture of the rice beers, such as *pachwai*. It is stated in the report of the Bengal Excise Commission (1883-84) that 166 different plants and 45 different species have been used in its manufacture. The authors were able also to collect over a dozen recipes from the *bakhar* manufacturers of Birbhum and Sonthal Parganas. It was found that one hundred varieties of roots and 30 varieties of stems, leaves and flowers including poisons—*datura*, *aconite* and *nux vomica*—are used by different people in its manufacture. The commonest ingredient is a plant called *Rannu* in Sonthali. Another common ingredient of the cakes is a plant known as *Serum lutui* (*Clerodendron serratum*) which is used especially to enhance the intoxicating properties of the beer. In the northern Himalayas a grass, *Hardcum vulgare* Linn., is employed in the manufacture of these ferments.

According to Ray (1906), the plants used in the preparation of *bakhar* may be divided broadly into four groups with respect to their known general properties:—

1. Medicinal plants, e.g., *Tribulus terrestris* (gokhur), *Desmodium gangeticum* (salpan), *Uraria lagopodioides* (chakulia), *Splanum jacoumni* (kantakari), *Hemidesmus indicus* (anantamul), *Asparagus racemosus* (satamuli), etc.
2. Bitter principles, e.g., *Andrographis paniculata* (kalmegh), *Oldenlandia herbacea* (khetpapr), *Azadirachta indica* (nim), *Justicia adhatoda* (basak), etc.
3. Certain tannin-containing plants, e.g., *Terminalia chebula* (haritaki), *Terminalia tomentosa* (poasil), *Cassia fistula* (sendal), *Diospyros tomentosa* (kendu), etc.
4. Narcotics, e.g., *Datura* (dhutura), *Plumbago zeylanica* (chita), *Strychnos nux vomica* (kurhila), *Cannabis sativa* (sinddhi), *Aconitum palmatum* (bikhuma), etc.

The first investigation of a scientific nature regarding *bakhar* was made by Ray (1906) and according to him the saccharification of rice and also the subsequent alcoholic fermentation are due to the activity of a micro-organism present in *bakhar*, to which he gives the name *Mucor torula*. The next investigation on *bakhar* was made by Hutchinson and Ram Ayyar (1915). Contrary to the view expressed by Ray, these authors concluded that the changes were brought about by two distinct classes of micro-organisms, namely, *Mucors* and yeasts. Interesting observations were also recorded by these workers with regard to the relative physiological activities of the different micro-organisms found in *bakhar*. A fungus named *Aspergillus oryzae* isolated from the Japanese *koji*, a substance analogous to the Indian *bakhar*, was found to possess the greatest saccharifying activity. Several specimens of *bakhar* were prepared in the Pusa laboratory by mixing pure cultures of *Aspergillus oryzae* and other *Mucors* with yeasts, and the comparative strengths of the alcohol produced by them from rice were recorded. Attempts were made by these workers to produce the crude *bakhar* from cultures of *Mucors* and yeasts. *Aspergillus oryzae*, a fungus isolated from *koji*, and several varieties of yeast were utilized in the preparation of different types of *bakhar*. The results, however, were not satisfactory. The maximum strength of alcohol obtained by the action of these *bakhars* on rice was 33.7 per cent (59 per cent proof) by volume, that recorded with ordinary crude *bakhar*, thus showing that the product obtained experimentally in the laboratory was not identical with the crude product. Although the peculiar apple-like odour associated with the growth of *Aspergillus oryzae* was present, the taste of the *pachwai* prepared from the laboratory *bakhar* did not generally come up to the standard and liking of the consumers. *Mucor amylomyces* used in European distilleries is very similar to the organism found in *bakhar* and other fermenting substances used in the preparation of these beverages.

(b) *Kemki roti*.—This is the ferment used in Jaunsar and in the western Himalayas. Powdered and dried roots of several hill plants\* are mixed with four times their weight of *mandwa* flour and made into a cake 2½ inches in thickness and 10 inches in diameter. The cakes are then covered with straw and placed in a dark room for eight days or so, depending on the time of the year; after this they are taken out and dried in the open air for four days. The black fungal growth which occurs on their surface is wiped off, and the cakes are then ready for use.

(c) *Murcha cakes*.—These are commonly employed in the eastern Himalayas, Assam and Bhutan hills. The outer skins of the roots of certain wild plants, such as *bhimsenpati* (*Buddleia asiatica*), *lour* and *wadding-hang-ma* (*Polygala arillata* Han), are dried, powdered and mixed with other ingredients in the following proportions: 6 oz. of dried roots, 1 oz. of dried ginger, 12 oz. of rice flour, and 6 chillies.

Sometimes one or two seeds of *Strychnos nux vomica* are added. The mass is kneaded into a dough with water and small round cakes are prepared from it. The cakes are dusted with an old powdered cake from a previously-manufactured batch, covered with fern leaves and kept in a dark room for three or four days. When taken out they are dried and, subsequently kept dry by storage near a fire-place.

The Lepchas and Lushis as well as the Nagas make rice beer without adding any special ferment.

\*The vernacular names of the plants used are *chhamur*, *artoo*, *mukrand*, *pahar*, *baru*, *charwa* or *chharants*, *doodh pal* and *souli*.

## 2. Cereals used and process of preparation

(a) *Pachwai and handia*.—These rice beers are the most extensively used of all the country beers. The process of manufacture is simple. Rice is boiled and spread on a clean floor or on a mat, mixed with finely powdered cakes of *bakhar* in 100 to 1 proportion, and left in an earthen vessel in a dark place, for fermentation. After 4 to 10 days or longer, depending upon the atmospheric temperature and the progress of fermentation, it is taken out. The mass is then diluted with water and distributed for consumption. The washings are repeated till the mass is bereft of all its alcoholic content and the rice is thrown away or given to pigs.

(b) *Sur and lugri* are similar beers prepared from fermented rice and sometimes from other cereals in Kangra district.

(c) *Zu*, a weak country beer, is the national drink of Angami Nagas. It is prepared by pouring boiling water on rice and leaving the infusion for two or three days in a dark place, whereby the fluid is fermented. It forms a refreshing and exhilarating drink. No special ferment is said to be added for assisting fermentation in the process of its manufacture, enough ferment being present in the unwashed troughs to start the process.

(d) *Marua* beers (i.e., *chang*, *jaur*, *niger*, *chanua*).—These beers derive their names from a millet called *mandwa* which forms the staple food in most of the hills. The grain is husked, boiled with water, cooled, and thoroughly mixed with the ferment *marcha*; two to four cakes of the ferment are added to a maund (82 lb.) of the boiled grain. The mass is then spread over the floor of a room to a depth of 8 to 10 inches and kept there for 42 to 48 hours to allow the moulds to develop and spread throughout the mass. The whole mass is then transferred to bamboo baskets wrapped in plantain leaves; this probably prevents the introduction of extraneous organisms from the air. The baskets are kept in a dark place for 15 to 20 days for the organisms to produce the desired effect. After this period the grain is ready for use. Some of the prepared grain is placed in a vessel consisting of a bamboo cylinder known as *changi*; hot water is poured into it and the mixture left for some time. The liquor is then drawn through a thin reed or a bamboo pipe. The vessel may be replenished repeatedly with hot water until the grain is exhausted. If an amount of water equal to that of the grain is added, the wash obtained is called *niger*; but if twice the amount of water is added the resultant beverage is called *chanua*. The alcohol content of the liquor, when used in this manner, is very low (less than 1 per cent by volume) and people take delight in sipping it from morning to evening. The percentage of ethyl alcohol rises to 6 or 8 per cent, only when the fermented grain is kept steeped in an equal amount of water for 24 hours.

(e) *Pakhwai*.—This is the common beverage in the western Himalayas and the Jaunsar Bewar Pargana of Dehra Dun district. It is prepared in a slightly different manner from that described for *marua* beers. A maund of the flour made from one of the common cereals, usually *mandwa*, is made into thick cakes, which are crushed, mixed with the ferment *kemki roti* and kept for four to five days in an earthen vessel of a capacity of about four maunds. Usually fermentation starts after this period. The vessel is next filled with water and again kept in a cool place for about six to eight weeks for the completion of fermentation. The resultant fluid is called *pakhwai*, and the semi-solid material left behind is called *rabra*. The latter contains alcohol and is used as food.

### Cereals used and composition of beers

The cereals most commonly employed are rice and *mandwa*. The husked grain has the following composition:—

|                   | Rice,<br>per cent | Mandwa,<br>per cent |
|-------------------|-------------------|---------------------|
| Water .. ..       | 12.8              | 13.2                |
| Albuminoids .. .. | 7.3               | 7.3                 |
| Starch .. ..      | 78.3              | 73.2                |
| Oil .. ..         | 0.6               | 1.5                 |
| Fibre .. ..       | 0.4               | 2.5                 |
| Ash .. ..         | 0.6               | 2.6                 |

During the process of manufacture, starch is converted into sugar, which is subsequently converted into alcohol. These changes are brought about through the agency of various moulds and yeasts present in the fermentation cakes. Moulds, such as *Phizopus*, *Cambodja*, *Demantium* and *Penicillium*, and one kind of yeast enter into the fermentation cakes either from the skin or roots of the various plants used, from the air, or from the green leaves used for converting the cakes during the process of their manufacture. The enzyme amylase secreted by these moulds changes the starchy matter into maltose, which is then converted into glucose and ethyl alcohol by the activity of the maltose and zymase of yeast. Fermentation enzymes are also secreted by the moulds to a small extent.

Besides diluted ethyl alcohol, these liquors contain starchy derivatives such as dextrine, malto-dextrine, maltose, etc., which have not been fermented. The food value of these liquors is, therefore, substantial. The nature of the by-products depends upon the character of the grain and the fermenting material used. In most of the fermented liquors glycerol is formed from decomposition of sugars by yeast; fusel oil is formed from amino acids by the decomposition of proteins present in the grain; succinic, formic and acetic acids and some other acids may be formed as a result of bacterial contamination. Besides these, many esters, aldehyde and ketone bodies responsible for the smell and taste of the fluids are formed.

*Alcoholic strength*.—The fermented mass has a semi-solid consistency and contains fair quantities of alcohol. The strength of the ultimate product depends partly upon the nature of the grain employed but more upon the amount of water added for dilution. The amount of water added varies in different places, amongst different tribes, and according to the occasion on which the liquors are used; for instance, the liquor drunk at festivals and marriage ceremonies is much stronger than that used for daily consumption. Bedford, at the instance of the Indian Excise Committee (Thomson *et al.*, 1907), examined the alcoholic content of a number of samples of rice beer collected in various parts of India, and his results are given in the following table:—

TABLE IV  
Average strength of country beers (1905-1906)

| Province               | Number of analyses done | Percentage of absolute alcohol by volume |
|------------------------|-------------------------|--|
| Bengal .. ..           | 8                       | 6.4                                      |
| Eastern Bengal .. ..   | 4                       | 6.9                                      |
| United Provinces .. .. | 1                       | 13.6                                     |
| Punjab .. ..           | 3                       | 6.3                                      |
| Burma .. ..            | 7                       | 9.9                                      |
| Mysore .. ..           | 1                       | 4.1                                      |

(Concluded on opposite page)

## ÆTIOLOGY OF GLAUCOMA, ITS VARIOUS METHODS OF TREATMENT AND THEIR MERITS

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GLAUCOMA is not a disease *sui generis*. A glaucomatous eye is only a diseased eye in a diseased body—its one characteristic being increased intra-ocular tension.

(Continued from previous page)

In the following table are given the results of the analysis of similar specimens examined at the Municipal Health Laboratory, Darjeeling, during recent years :—

TABLE V

The results of the analyses of country beers carried out at the Municipal Health Laboratory, Darjeeling

| Number | Specimen                      | Specific gravity | Percentage of ethyl alcohol by weight | Percentage of alcohol by volume |
|--------|-------------------------------|------------------|---------------------------------------|---------------------------------|
| 1      | Undiluted pachwai and chanua. | 0.9870           | 13.1                                  | 22.9                            |
| 2      | Undiluted pachwai and Niger.  | 0.9981           | 10.68                                 | 18.7                            |
| 3      | Undiluted chanua.             | 0.9894           | 2.65                                  | 4.6                             |
| 4      | Diluted pachwai and Niger.    | 0.9915           | 10.85                                 | 19.0                            |
| 5      | Do.                           | 0.9803           | 4.33                                  | 7.6                             |
| 6      | Do.                           | 0.9864           | 4.03                                  | 14.1                            |
| 7      | Chanua                        | 0.9888           | 6.71                                  | 14.6                            |
| 8      | Do.                           | 0.9968           | 1.8                                   | 4.0                             |
| 9      | Do.                           | 0.9933           | ..                                    | 8.7                             |
| 10     | Do.                           | 0.9945           | ..                                    | 6.8                             |
| 11     | Do.                           | 0.9884           | ..                                    | 12.9                            |
| 12     | Do.                           | 0.9915           | ..                                    | 10.8                            |
| 13     | Do.                           | 0.9895           | 7.5                                   | 13.5                            |
| 14     | Do.                           | 0.9905           | 9.09                                  | 12.4                            |
| 15     | Do.                           | 0.9888           | ..                                    | 14.6                            |
| 16     | Do.                           | 0.9932           | ..                                    | 8.29                            |
| 17     | Niger                         | 0.9865           | 8.29                                  | 18.03                           |
| 18     | Do.                           | 0.9944           | 3.1                                   | 7.0                             |
| 19     | Do.                           | 0.9894           | ..                                    | 3.7                             |
| 20     | Do.                           | 0.9930           | ..                                    | 8.75                            |
| 21     | Do.                           | 0.9896           | ..                                    | 14.5                            |
| 22     | Do.                           | 0.9894           | ..                                    | 13.7                            |
| 23     | Do.                           | 0.9932           | 5.0                                   | 8.7                             |
| 24     | Do.                           | 0.9822           | 14.18                                 | 24.8                            |
| 25     | Do.                           | 0.9899           | ..                                    | 12.95                           |
| 26     | Do.                           | 0.9876           | ..                                    | 16.4                            |

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(Part II will appear in our next issue)

The disease is divisible into the following two groups :—

1. *Primary glaucoma*—also called idiopathic glaucoma. It may be acute or chronic. Chronic glaucoma comes on without any evident fundamental cause.

2. *Secondary glaucoma*.—There is always some evident cause to explain its onset.

### 1. PRIMARY GLAUCOMA

#### (a) *Acute glaucoma*

*Ætiology*.—The exact cause is an unsolved problem. According to Priestly Smith the most probable cause is the growing lens with advancing age, which by narrowing the circumlental space causes obstruction to the aqueous secreted by the ciliary processes. This narrowing becomes all the more acute in any sudden congestion of the ciliary body. The lens is thereby pushed forwards and by pushing the iris in front of it, it causes obstruction of the irido-corneal angle, thereby causing obstruction to the outflow of the aqueous and an onset of acute glaucoma. A spontaneous diminution of congestion of the ciliary body may for the time being cause subsidence of the acute attack until such time that the attacks are repeated leading to chronic glaucoma.

Primary glaucoma is a disease of the late adult, is commoner to Jews and is sometimes hereditary, in which cases it shows anticipation.

It is commoner in the female sex who are prone to suffer from congestion in various parts of the body and more subject to emotional influences; also near the climacteric period when there is an endocrinal disturbance leading to sympathetic-parasympathetic imbalance, the correct working of which is responsible for the proper working of the vascular system.

The disease is commoner in hypermetropes than in myopes—in the former, probably due to small eyes with small corneæ and consequently a narrower circumlental space, which is further narrowed from the hypertrophy of the ciliary body due to a constant effort at accommodation. With increasing age the anterior chamber becomes shallower, causing narrowing of the angle of filtration. This, combined with sclerosis of the pectinate ligament, natural to old age, leads to obstruction in the outflow of the lymph. Any sudden narrowing of the angle, e.g., crowding together of the iris under atropine, may precipitate an attack. In this connection it is interesting to note whether atropine leads to glaucoma by crowding together of the iris and narrowing of the filtration angle or by relaxing the tone in the vast vascular area of the uveal tract, because suprarenin, in spite of dilatation of the pupil, causes lowering of tension instead of causing a rise. The mere swelling of the lens in cataract may induce glaucoma in eyes predisposed to it.

Koepppe and Barkan have shown deposits of pigment granules and flakes of the anterior capsule of the lens blocking the filtration angle and



the meshes of the pectinate ligament in old age, and they consider these factors as important causes in the ætiology of glaucoma. The theory of formation of aqueous by the glandular activity of the epithelium of the ciliary processes has given way to that of dialization from the blood plasma through a semi-permeable membrane—the capillary walls. It has been established that glaucoma is a symptom complex of vascular origin, the capillary and venous stasis playing an important part and the glaucomatous eye being a sick eye in a sick body reacts to it. It has been established beyond doubt that increased permeability plays an important part in the ætiology of glaucoma associated with epidemic dropsy. It is probable that the histamine-like body which has been proved to be present in epidemic dropsy and the action of which is normally neutralized by the tonic constrictor effect of the pituitary and the adrenals, may predispose to glaucoma. That it is the vascular element, which plays a more important rôle in the ætiology of glaucoma and not the obliteration of the filtering angle, is shown by the effect of adrenalin which in spite of dilatation of the pupil reduces tension by constriction of the arterioles and thus reduces engorgement.

In this connection it may be relevant to say that eserine acts not by the contraction of the pupil, but by stimulation of the parasympathetic, producing increased flow by the dilatation of the arterioles, the action of atropine being harmful by a directly antagonistic action producing stasis of the vast vascular area of the uveal tract. Pilocarpine and acetylcholine, like eserine, also act by stimulating and assisting the venous return. In the sympathetic parasympathetic control of the intra-ocular circulation, preponderance of sympathetic irritation leads to dilatation of capillaries and congestion of the uveal tract.

This is borne out by abolition of the sympathetic stimuli after the excision of the cervical sympathetic, which lowers the intra-ocular tension. Septic and other irritation factors have also an influence in raising the tension, *e.g.*, the increase of tension sometimes following herpes ophthalmicus.

Further factors in the control of the tone of blood vessels are the action of hormones of the suprarenals, the thyroid and the pituitary. The fact that stasis plays an important part is further revealed by the tension in the eye being at its highest between 3 and 6 a.m., when the circulation is at its lowest throughout the body, and it is common knowledge that the disease had a predilection for this period of the day.

Arteriosclerosis forms a further basis of the lack of velocity in the vascular tone and that is probably one reason that the incidence of glaucoma increases with age. Apart from this, high blood pressure is not an essential, not even an important, factor in the ætiology of glaucoma.

Its occurrence in the glaucomatous age is accidental and not essential. On the other hand, obstruction to venous outflow is a more important factor, this being revealed by a perivascular infiltration in the anterior ciliary veins and in vortices in glaucomatous eyes. Earlier onset of increased tension in tumours of the ciliary body more than in tumours further back is also explained by the pressure over the vortices in the former, apart from pushing forward of the iris and narrowing of the filtering angle. That vasomotor disturbance plays an important part in the ætiology of glaucoma is further borne out by the onset of glaucoma at the height of an emotional crisis and at the climacteric period in women, when such disturbances are common. Certain factors associated with glaucoma, *e.g.*, optic atrophy and glaucomatous cupping, are also attributed to the vascular changes rather than to increase of the intra-ocular pressure. Troncoso attributes atrophy of the optic nerve to malnutrition all over the retina through ischæmia due to sclerosis of the artery supplying the retina and the optic nerve, or to functional ischæmia in which there is impairment of velocity of the blood flow, leading to inadequate outflow of the toxic products, which leads to degeneration without inflammatory reaction, and Schnabel explains the cupping of the nerve head by the retractile influence of the cicatricial tissue in the retrobulbar portion of the nerve and the ischæmic degeneration of the sclerotic resulting from arterio-sclerotic changes.

Stasis in the uveal tract results in accumulation of toxic metabolites such as carbon dioxide, lactic acid and chlorine, and some of these cause a toxic degeneration of the retina. It is on the basis of some of these facts that Fischer and Thomas have tried to reduce the tension of the glaucomatous eyes by giving subconjunctival injections of sodium citrate. Inflammation plays little part in production of glaucoma, as is evident in iritis in which, in spite of the highly albuminous aqueous loaded with white and red cells, tension does not rise very much. Only in the presence of stasis of circulation in capillaries and veins does inflammation produce obstruction.

*Treatment of acute glaucoma.*—The treatment should be energetic. For a short time medical treatment may be tried till preparation can be made for surgical treatment. This consists in reducing general vascular and intra-ocular tension by purgatives, intravenous injections of hypertonic solutions, *e.g.*, 100 c.cm. of 50 per cent sorbitol or a 10 per cent saline 150 to 200 c.cm. It is particularly useful in cases going dangerously high and in cases in which tension cannot be controlled by miotics or their use is considered undesirable on account of plastic exudates. During this period eserine (1 per cent) may be put in every 5 minutes for the first half hour, one drop being placed in the healthy eye as well, and then every half hour

till tension falls. Hot fomentations and aspirin give relief. If after an hour or two no improvement in tension occurs, a combination of 20 per cent solution of mecholyl—a derivative of choline with 5 per cent solution of prostigmine—has given good results. Acetylcholine and its derivative doryl by influencing the tone of the blood vessels in favour of parasympathetic predominance in contrast to sympathetic predominance, also act beneficially. Doryl has more prolonged therapeutic effect than acetylcholine. It has a complementary action in conjunction with eserine. Addition of 1 per cent solution of doryl in equal proportion of  $\frac{1}{2}$  per cent solution of eserine has a more prolonged effect in glaucomatous cases. The use of doryl by intramuscular injection is also a reliable addition to our armamentarium. The efficacy of heparin in the thrombosis of the central renal vein is an encouraging thing in the treatment of acute glaucoma, because these patients show a diminished coagulation time. Amino-glucosan has been tried in acute glaucoma but its action is transitory and uncertain.

If after a couple of hours of the above treatment there is no improvement in tension iridectomy should be done—a broad glaucoma iridectomy. This is a very difficult task in the acutely congested eye under tension. Retrobulbar injection of novocain through paralysis of ciliary ganglion, perhaps by abolition of excess of sympathetic irritation, helps to lower intra-ocular tension and must be carried out before doing glaucoma iridectomy. In cases where the anterior chamber is extremely shallow the classical iridectomy is very difficult and dangerous, as the lens or the back of the cornea may be injured, and this is apt to be followed by a small prolapse of the iris and even at its best by a certain amount of astigmatism afterwards. *Trap-door iridectomy* short circuits these difficulties. The operation is performed like the ordinary corneo-scleral trephining, except that the disc is not removed but allowed to remain connected by its upper edge, as if through a hinge. The prolapsed iris is snipped off and the disc replaced. The surface of the sclera is smoothed down and the flap sutured in place. The advantages of this operation are the following :—

1. No possibility of wounding the lens or the cornea.
2. The iris is detached from its peripheral attachment.
3. No post-operative astigmatism.
4. Any prolapse occurring is well covered by the conjunctiva and Tenon's capsule.
5. Majority of cases get a permanent filtration.

Another useful operation in acute glaucoma is iridencleisis (for technique see under chronic glaucoma). If the anterior chamber is not very shallow in congestive glaucoma, iridencleisis is more effective than a classical iridectomy. While doing any of these operations in acute glaucoma one must make sure about the condition of the lachrymal sac. If there is lachrymal mucocele the canaliculi may be ligatured or

the puncta cauterized. Tension sometimes continues to be high in acute glaucoma after operation. In these cases a trial with lævo-glucosan may be given before another operation is undertaken. A word of caution should be given against the continuous use of lævo-glucosan for any length of time. It should not be used continuously without interruption and preferably not without any control, particularly in very old persons, for fear of necrosis. Hamburger recommends glucosan massage of the eye instead of instillation of drops whereby dilatation of the pupil to maximum is prevented. He reports that since adoption of this method instead of drops, he has never seen any acute rise of tension. The steps of glucosan massage are as follows :—

1. Apply before noon so as to have plenty of time for observation.
2. The pupil should be at maximum contraction having been treated with eserine already at least 30 minutes previously before massage.
3. Anæsthetise with a drop of procain.
4. Apply glucosan massage with a probe having a cotton-wool wadding at its end and take care that no glucosan runs into the conjunctival sac. The massage should be applied to a spot near the limbus for 10 seconds.
5. If the pupil does not react sufficiently, repeat massage after 20 to 30 minutes.
6. One and a half to two hours after glucosan massage instil eserine.
7. Patient must not be allowed to go away until pupil begins to contract.
8. Never treat both the eyes at one sitting.
9. Always treat the more affected eye first. Massage can be repeated next day.

#### (b) Chronic glaucoma

*Ætiology.*—In this condition, symptoms are sometimes completely absent till loss of visual activity and fields of vision are extreme. The rise of intra-ocular tension, which is such an important feature of acute glaucoma, is not a marked and constant feature. It resembles acute glaucoma in the presence of optic atrophy with cupping of the disc and the nasal step of Roenne in the visual fields. The fundamental and underlying cause is the defective circulation. Even such facts as optic atrophy are believed to be due to this cause producing ischæmia through the artery supplying the retina and optic nerve or to functional ischæmia in which there is impairment of velocity of the blood flow leading to inadequate outflow of toxic products. This leads to toxic degeneration without inflammatory reaction, mostly marked in the temporal part of the optic nerve and the retina, where, due to overcrowding of the nerve fibres, even a low grade œdema will lead to a great deal of pressure effect. In a case of chronic glaucoma the optic nerve is seen to be shrunken. Pressure from inside the eye cannot produce this picture. In fact it will lead to thickening of the nerve behind the lamina cribrosa. Diminution of light sense also favours the theory of insufficiency of choroidal circulation in early phases. In contrast to acute

glaucoma, emotional changes leading to sympathetic-parasympathetic imbalance, hormone instability and peripheral influences do not play such an important part as arteriosclerosis and venous endothelial thickening. Hence, while the incidence of acute glaucoma is greater in women, the incidence of chronic glaucoma is almost the same in both sexes—perhaps somewhat higher in males. It also explains the progress of optic atrophy, in spite of lowering of intraocular tension by eserine in cases of chronic glaucoma. The cupping of the optic nerve is the recession of the lamina cribrosa probably resulting from ischæmic degeneration of the sclera from arteriosclerosis. The correction of underlying circulatory disorders, the removal of any septic foci in the nose, teeth and tonsils and the abolition of any painful reflexes have an important place in the disease. In contrast to the ordinary primary glaucoma, stands out the glaucoma in epidemic dropsy. In this there is never any evidence of inflammation and the two outstanding features are the vasodilatation of the whole capillary system and an increased permeability of the capillary endothelium. In the eye, microscopic examination of the filtration angle shows that the canal of Schlemm and the tissues in the immediate vicinity do not show any abnormality either in cellularity or in increased fibrosis. Increased dilatation of the blood tissues is seen in the subepithelial tissues of the ciliary processes. There is also dilatation of the capillaries of the choroid. One prevalent opinion is that the disease is due to the ingestion of diseased, stored or parboiled rice as the patient recovers quickly on the stoppage of rice in early cases. Relapses occur quickly even when healthy rice is eaten again, suggesting that the infection of the rice occurs in the intestines. In this variety of glaucoma there is high tension in both eyes which cannot be lowered by miotics. The anterior chamber is narrow or deep and there is absence of any inflammation. Corneo-scleral trephining has to be done. It has been abundantly discussed that glaucoma is not a disease *sui generis* and the importance of extra-ocular influences like diminution of calcium content of the blood, the changes in capillaries leading to the increased permeability, the influence of the sympathetic in the control of size of blood vessels of the ciliary body and the choroid, by automatically causing their contraction to prevent filling, and the influence of hormonal secretions of the adrenals, the thyroid and the pituitary have all been mentioned. A few other factors concerning extra ocular-influences are worth mentioning, *viz.* that in glaucomatous cases, while there is a rise of calcium salts in the blood, there is decrease of potassium and chlorides; there is increase of red cells in blood and the large mononuclears have been found to have increased as much as 15, 20 or even 30 per cent. According to Wright, the toxins in circulation in these cases interfere with the function

of the reticulo-endothelial system. Of the endocrine changes, marked increase of folliculin in urine, in correspondence with the increase of intra-ocular tension, is a point of interest.

*Treatment of chronic glaucoma.*—On the basis that toxæmia is one of the underlying causes it is justifiable to try elimination of toxins by conservative methods, *e.g.*, rest in bed, restricted diet, free intestinal action, diaphoresis and action of kidneys. This explains the beneficial results of intravenous hypertonic saline, concentrated glucose injections and the benefit from such drugs as adrenalin and ergotamine. Irradiation of the body does good by acting on the vegetative nervous system and irradiation of the thyroid has led to improvement of vision and visual fields. Insulin has also been made use of to produce fall of tension. On the basis that stasis in uveal circulation results in accumulation of toxic metabolites such as carbon dioxide, lactic acid, and choline and increased acidity locally, Fischer and Thomas have succeeded in reducing the tension of glaucoma by giving subconjunctival injections of sodium citrate. Calcium salts by decreasing the permeability of the uveal capillaries have proved to be of benefit in glaucoma. Other conservative measures in the treatment of chronic glaucoma consist of correction of ametropia, giving attention to the allergic states in the vicinity (facial and trigeminal nerves), medication regulating sympathetic imbalance (eserine, salicylates, gardenal or luminal and opotherapy). Also treatment with calcium chloride and iodides and cardiovascular tonics, correction of hyperglycæmia and antiseptic medication. All these measures are highly beneficial provided the action of miotics is never arrested. Ergotamine has proved useful in chronic glaucoma by lowering tension and causing constriction of the pupil and it can be given by mouth. Besides these measures the conservative treatment of chronic glaucoma consists in the prolonged use of 0.5 per cent eserine or 0.25 per cent of pilocarpine once or twice a day. Massage with the finger-tips is also useful. Where diagnosis is uncertain or operation is refused, the above line of treatment is essential. Glaucozan is capable of reducing tension where eserine and pilocarpine have failed. Trial should be given before operation, not by drops but by massage (for method *see* under acute glaucoma). If the circumscribed massage has been well borne, one drop of glaucozan should be put in the eserined eye. After half an hour at least, apply miotics at intervals of 15 to 20 minutes so as to make the pupil narrow again and to maintain the miosis. A great advantage of glaucozan is that it can be used as a mydriatic for fundus examination in suspected glaucoma cases. When the above line of treatment fails and there appears to be some loss of field of vision, operative treatment is unconditionally advised for chronic glaucoma.

The aim of operative treatment is to provide a filtering channel of some sort. Elliot's corneo-scleral trephining, which is so commonly practised in chronic glaucoma, is uncertain at times in its results and is liable to be complicated by serious changes, both immediate and remote. Rarely, the operation may cause a sudden and complete loss of whatever vision is present in an advanced case. As a prophylactic measure operation in the sound eye is inadvisable, till some contraction of the field of vision occurs, and hence the patient should be kept under observation and the field of vision recorded from time to time. Weak pilocarpine on alternate days may be put in the sound eye as a prophylactic measure, and general regime ordered to avoid cerebral congestion. The essentials of a good operation are:—

1. The filtering channel should be through a permeable cicatrix.
2. The filtration should not be limited to one area, but should be diffused over a wide area.
3. It should be permanent but not excessive, so as to avoid hypotonia.
4. It should not cause excessive trauma and should not be followed by iritis or ciliary injection.
5. The cicatrix, though permeable, must be covered with a layer of conjunctiva, so that the risk of infection to the eye is minimum.
6. The cosmetic effect should be good. Unsightly blebs and lumps must be avoided.

The above being the essential features of a good operation, Elliot's operation is disadvantageous in the following respects:—

1. The operation is followed by considerable injection and even sometimes by frank iritis, for which reason atropine has to be put in after the operation.
2. In a large number of cases ectatic blebs will form at the site of operation, which bulges the eyelid, producing an ugly deformity and it is a constant menace to the integrity of the eye.
3. The development of myopia after operation is common. This gradually passes off but some of it may remain.
4. Late formation of anterior-chamber is not rare and is always a source of anxiety lest it may lead to the development of nuclear cataract.
5. Post-operative cataract developing later on is common; according to Harrison Butler about 10 per cent.
6. Late infection resulting in total loss of the eye has been known to occur.
7. Occasionally the trephined eye becomes hypotonic.

Thus the corneo-scleral trephining, though giving an excellent percentage of good results, sometimes gives very disappointing failures. For these reasons some surgeons prefer iridencleisis. Its advantages are:—

1. It causes less disturbance in the eye and rarely any marked post-operative injection, and post-operative iritis hardly ever occurs. It is never necessary or advisable to use atropine and the patient can leave the hospital and return to work within a week. Trephining takes longer.
2. The ectatic scar is very rarely seen. The pupil, contrary to what one might imagine, is never drawn up.
3. Changes in refraction after iridencleisis is very uncommon. A slight myopia is only transitory.
4. Late formation of anterior chamber is not seen.
5. Post-operative cataract does not occur.
6. Late infection is very rare.

7. Hypotony does not occur. In fact it takes some time before the tension comes down and sometimes massage is necessary.
8. Cases after operation probably show remarkable enlargement of the field of vision, which is not so well marked in trephining. Iridencleisis is as successful in acute glaucoma as in the chronic variety.
9. The dangers of sympathetic ophthalmia and irritation from iris inclusion, as one might anticipate, have proved to be unfounded, because the iris inclusion is well covered, not only by the conjunctiva, but by the Tenon's capsule also. The only real objection to iridencleisis is, that its effect is said to be slow and that if after-care is not taken conscientiously, the filtration will be ineffective. The following statistics (after Harrison Butler) show that iridencleisis is superior to trephining:—

|                       | Acute glaucoma   | Iridencleisis | Trephining |
|-----------------------|------------------|---------------|------------|
| 1. Successful         | 83.3 per cent    | 54 per cent   |            |
| 2. Cataract formation | 0.0 "            | 0 "           |            |
| 3. Total loss         | 0.0 "            | 24 "          |            |
|                       | Chronic glaucoma |               |            |
| 1. Successful         | 93.2 "           | 70 "          |            |
| 2. Cataract formation | 0.0 "            | 10 "          |            |
| 3. Total loss         | 0.0 "            | 4 "           |            |

*Technique of iridencleisis.*—No antiseptic is used before operation. A drop of eserine is put in with the first application of cocain, so as to prevent the dilatation of the pupil. Tenon's capsule is picked up with forceps, after making an incision with squint scissors horizontally about 10 mm. above the limbus, it is carried to the sclera and a small pouch is made with a few snips of scissors. The assistant, picking up the point of the flap, a narrow keratome is placed upon the sclera 3 mm. from the limbus and the flap is dropped over the blade of the knife, which is pushed slowly into the chamber. The point of the keratome is brought to the level of the centre of the cornea and is drawn in a sideways movement to make the opening rectangular. By lifting the flap again, the iris is caught near the sphincter with Matthieu's iris forceps and is half incised with De Wecker's scissors. The flap is smoothed into its place and the operation is complete. No after-treatment is called for.

*Lagrange's operation.*—The knife required for this operation should be narrow and thin but not flexible. The Nicaty knife is good, but a sclerotome is better. For the right side, the eye is fixed near the limbus at the 7 o'clock position and the knife is held in the right hand. For the left eye it is fixed at 5 o'clock position with the right hand, and the knife held in the left. The scleral portion present at the apex of the irido-corneal angle is about 1 mm. wide and the scleral section must be made at this site. The tissues to be excised should consist only of the sclerotic without any corneal tissue at the base of the flap, since the corneal tissue has a tendency to proliferate and may obstruct the scleral orifice. The ciliary body must not be injured. The incision must not be so wide as to permit the escape of the vitreous. In operation for the left eye the puncture should be made at the 1 o'clock position about 2 mm. behind the limbus, and the tip directed towards the anterior chamber towards the centre of the pupillary orifice. The knife is stopped as soon as the tip is visible in the irido-corneal angle and can work freely there. The knife is now turned so that its flat surface is on the iris while the edge is at the bottom of the irido-corneal angle, which it gently touches and the knife is pushed in so as to make a counter-puncture at a point symmetrical with that where the original puncture was made. The scleral flap is formed by slightly sawing movements. The scleral wound now gapes, its lower lip constituting the apex of the flap whose height was determined by the position of the puncture. Now form the conjunctival flap and lift it up with an iris forceps so as to dissect beneath it a fragment of the sclerotic in a direction parallel to the limbus with a modified Vaucher's punch. The

sclerotomy thus performed is completed by a peripheral or total iridectomy. Iridectomy can be performed simultaneously with sclerectomy by the punch forceps. The operation succeeds in about 85 per cent of cases of chronic glaucoma, while in ordinary glaucoma iridectomy there is only an average of about 25 to 30 successful cases per hundred. Operative accidents are negligible. There is no risk of early or late infection. The 10 to 15 per cent of failures are due to lesions of the blood vessels of the retina or in the optic nerve, whose degeneration cannot be arrested by any means.

*High-frequency current.*—This has the effect of lowering the tension in nearly all moderately hypertensive eyes. The method should not be utilized in inflammatory cases and the application should not be longer than 1 to 4 minutes, and although the effect is more or less transitory, the application does good in the long run. In order to avoid startling the patient the current should not be turned on until contact has been made with the skin.

*Cyclodiathermy puncture in glaucoma.*—This is a valuable anti-glaucoma operation. It is free from such dangers as sympathetic ophthalmia and panophthalmitis. The method is particularly useful where iridectomy and the operations for subconjunctival filtration have failed. It is of particularly great use in malignant forms of glaucoma where the anterior chamber has disappeared, also in ineffective iridectomy and trephining. No operation from iridectomy up to iridencleisis and sclerotomy has been possible up till now without the presence of an anterior chamber. The danger of this method lies to the cornea and the lens in particular. The diathermy needle should not be brought closer than  $2\frac{1}{2}$  mm. from the limbus. The needle under no circumstances should be longer than 0.5 mm. from its point to the stop. In aphkic cases it may be 1 mm. long. A hyperæmic iris and increased opaqueness of the anterior chamber follow one to two days after the operation. It is important to set up a slight lesion of the vitreous without injuring it too much. The punctures are numerous. A cyclodiathermy puncture which begins  $2\frac{1}{2}$  mm. from the limbus and reaches 4 to 5 mm. behind, lies over the ciliary body and goes up to the ora serrata. Mention must be made of the possibility of necrosis of the sclera. As many as 100 to 200 punctures have to be made in the area of an arc 3 mm. behind the limbus, running from the medial to the lateral rectus. The eye is very hypotonic after the operation. Sometimes it takes several days.

Finally, in the treatment of chronic glaucoma glaucosan must be tried in cases unsuccessfully operated upon, before trying other operations, at first cautiously and then once or twice a week. Some use it as frequently as two to three times a day alternately with miotics.

#### *Absolute glaucoma*

Sooner or later tension in the glaucomatous eye becomes normal or even diminished and the condition passes into a state of absolute glaucoma due either to the stretching of the

walls or degeneration of the ciliary body. Such an eye may even shrink, but more commonly ulceration of the cornea occurs. Hypopyon ulcer, panophthalmitis, and phthisis bulbi are the fate of such eyes ultimately. In absolute glaucoma pain is best relieved by hot bathing and aspirin internally. It is advisable to excise such an eye since there is always a risk that the cause of glaucoma may be intra-ocular growth, usually a sarcoma of the choroid which may be left behind if the eye is not excised.

## 2. SECONDARY GLAUCOMA

*Ætiology.* (i) *Trauma.*—This may cause intra-ocular hæmorrhage or perforation of the cornea. The intra-ocular hæmorrhage by pushing the lens and the iris forwards causes anti-synechia and by increasing the viscosity of lymph and blocking the canal of Schlemm by the blood cells leads to obstruction in the outflow. In perforating injuries, anterior synechia cause narrowing of the angle of filtration and thereby the increased tension. The synechia may not be of the iris alone but of the lens capsule. These synechiæ push forward the iris, causing obliteration of the angle.

(ii) *Uveitis.*—Plastic iritis leads to annular posterior synechia which prevents the escape of aqueous into the anterior chamber, and pushing the iris forwards—iris bombé—leads to obliteration of the angle, causing rise of tension. The obstructed lymph behind an annular synechia causes pressure-atrophy of the ciliary processes, which ultimately causes a fall of tension in the eye. The inflammatory process, by formation of a layer of exudate behind and between the fibres of the suspensory ligament of the lens, prevents the exchange of fluids between the aqueous and the vitreous, leading to increased tension.

(iii) *Cataract extraction, wounds of the lens and discission.*—In cataract extraction and wounds of the lens, the capsule may get incarcerated in the corneal wound, and by pushing forward the iris will lead to obliteration of the angle. The lens particles, by increasing the albuminous contents of the aqueous, further lead to obstruction of outflow, thereby causing increased tension. In discission the vitreous may get into the anterior chamber, causing obstruction to the outflow and thereby increased tension. After cataract operation, the edges of the wound may not unite well and the epithelium advancing inwards may line the anterior chamber and thus shut off the canal of Schlemm.

(iv) *Thrombosis of the central retinal vein.*—By causing hæmorrhage in the eye and pushing the vitreous, the lens and the iris forwards and by increasing the viscosity of the lymph by the additional albuminous content cause restriction to the outflow of aqueous and hence increased tension.

(v) *Dislocation of the lens.*—If complete into the anterior chamber, the tightly-contracted iris behind it obliterates the angle. If partially



dislocated, it pushes the iris in front of it and causes obliteration of the corresponding portion of the angle and increase of tension.

(vi) *Intra-ocular tumours*.—The factors which caused increased tension work not by the increase of volume only and the distension of the eye so much as by the position of the tumour. Those in the anterior half of the globe raise the tension more than those more posteriorly, by impeding the venous return by encroachment on the ciliary body and the vorticosae veins as well as pressure on the filtration angle. With obstruction to the capillary and the venous return, secondary changes in the form of perivascular infiltration by small white cells play an important part. Eyes removed for the tumours show that those in which there is perivascular infiltration, particularly of the anterior ciliary vessels, have shown an increased tension while those in which in spite of large intra-ocular growths there was no perivascular infiltration, particularly of the anterior ciliary veins, showed no increased tension during life. Hence perivascular infiltration, particularly of the anterior ciliary veins, is an important cause of rise of tension. Cycloplegia, serpent ulcers by causing iritis and annular posterior synechia, and radium therapy have also been known to give rise to secondary glaucoma.

*Treatment of secondary glaucoma*.—In cases due to injuries, the treatment varies in different cases, e.g., in a case of hæmorrhage in the anterior chamber, irrigation through a keratome incision and the use of some tension-lowering agent, e.g., 50 per cent sorbitol intravenously, proves useful. In cases of secondary glaucoma due to a swollen traumatic cataract, solution of gum acacia intravenously and miotics for several days, followed by expression of the cortex give good results. In cases of injury look for rise of tension, and when it occurs the use of miotics is desirable in some cases, while in others paracentesis or iridectomy is better. In hæmorrhage in the anterior chamber, if atropine is used, be on the look out for rise of tension. In cases of tension going dangerously high, in cases of iritis, a continuous use of miotics must be made and as soon as the tension falls use mydriatics. In cases in which tension could not be controlled by miotics, or their use was considered undesirable on account of plastic exudates, use of intravenous hypertonic solutions—100 c.cm. of 50 per cent dextrose or an equal amount of 50 per cent sorbitol or 150 to 200 c.cm. of 10 per cent salt solution—has given good results in reducing the tension. Instillation of a combination of 20 per cent solution of mecholyl, a derivative of choline, with a 5 per cent solution of prostamine has given good results, where miotics and epinephrine have failed. In secondary glaucoma cyclo-diathermy puncture is of use, when simple iridectomy has not proved enough. Iritis is no contra-indication to it. Cyclo-diathermy puncture may also be attempted in glaucoma hæmorrhagicum, e.g.,

after obstruction to the central retinal vein. In secondary glaucoma, due to adhesions of the iris to the lens capsule after cataract operation, glaucosan may be tried; it is also useful in breaking up the adhesions of the iris to the lens capsule in secondary glaucoma due to iritis, short-wave and diathermy therapy also hold out useful prospects of benefit in cases of iridocyclitis with secondary glaucoma. Where all these methods have failed in secondary glaucoma after extra-capsular cataract extraction and discission, cyclodialysis is a useful operation. There is no danger of presentation of the vitreous; the pillars of the iris and the tags of the capsule can be separated from the scar by the spatula, and the lymph-channel created by the separation is likely to remain open. It can be repeated in other quadrants if necessary.

*Technique of cyclodialysis*.—Fixation is made with a Gifford's fixation forceps on the tendon of the superior rectus, and maintained right up to the close of the operation. The incision is made 7.5 mm. behind the limbus, between the superior rectus and either of the horizontal recti, and is made to the inner or the outer side according to which pillar appears adherent. The incision is made bevelled at an angle of 45 degrees, a fine suture through the sclerotic tongue is put on through a Kalt needle. The incision through the sclera must be extended through a length of 3 to 4 mm. so as to allow free play to the spatula. After this with a Holth punch, a semi-oval button about 3 mm. is excised from the scleral tongue. A narrow spatula is introduced through here hugging the sclera and is directed into the area of the coloboma. Both pillars and an area of iris root to the extent of one quarter of the corneal circumference are freed, and the sclera for several millimetres around the incision is also undermined. A running suture closes the conjunctival incision.

After the operation, a 0.5 per cent eserine solution is continued so as to prevent adhesions of the iris root to the sclera, except in cases of marked hæmorrhage in the anterior chamber. In these cases employ homatropine or neo-synephrine. Both these drugs should be replaced by miotics as soon as the blood is absorbed. Miotics should be discontinued if acute hypotonia occurs. In cases of secondary glaucoma occurring after uveitis, iridectomy is the operation of choice, and in those following cataract extraction and discission, cyclodialysis.

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## Medical News

### INDIAN EUGENICS SOCIETY

In presenting the first Bulletin of the Indian Eugenics Society which includes a paper on 'Aims and Objects of Eugenic Researches in Bengal' by S. S. Sarkar, Dr. B. K. Chatterjee, the president of the society, writes as follows:—

Ten years ago, a handful of research workers were thrown together in the Indian Museum, Calcutta, and the little time they could snatch away from their daily work was devoted to discussions of various problems of Indian life and society—race, history, demography, etc. The new science of Eugenics featured largely in these discussions.

Looking back in time we feel that the profound disillusionment characteristics of the decennium, has much to do with the birth of the eugenic idea in our minds.

For a century the people of Bengal had set their hopes upon Modern Education as the means of initiating a renaissance in the country. They had hopes to have much from the new spirit of politics, from social reforms, from religious revivals, from the growth of individualism and what not! There were wide differences of opinions on almost all points at issue. There was no lack of dreamers who worked, suffered and sacrificed for the realization of their dreams and there was a secret illusion in the hearts of many that our people had marched a few steps towards strength and modernization.

By the early thirties of the present century, when the idea of an eugenic movement took shape in our minds, however, the hopes of a hundred years had been shattered. It could no longer be ignored that we were wanting in what were vitally necessary not only for our survival, but also for our emergence as a modern nation.

The founders of the society concentrated themselves not only in the laboratory but also lived in society, in association with common men and women whose qualitative characters ultimately determine the fitness of a people to survive. Experience thus gathered from day to day in direct contact with the people led them to put the question—are our physical and mental powers, our moral calibre adequate for us to survive in the struggle for existence? If not, could these same powers be enhanced and our moral and intellectual calibre strengthened so that our people may purchase a new lease of life?

These questions cannot be answered by a simple yea or nay, for they are concerned with the complicated phenomena governed by multiple factors. If in some parts of India the physique of the population was poor, how far was it attributable to race and constitution and to what extent were malnutrition and climatic influences responsible for the same? How does it affect the psyche of the people? And—come to think of it, are not the nature of the social organization in India, the family life, the relations of the sexes, in short, our social *milieu* responsible for much in our mental equipments which have led to our failure in the past? Was the individualistic outlook of our philosophies, in so far it had become a mental habit of

the population, also not one of the factors which ultimately led to our collapse?

While we were by no means inclined to underestimate the effects of such environmental factors on our character, we felt that the crux of the matter lay in the nature of the stocks which constitute our population. These stocks could be classified into several zoological races, more or less evolved. They embrace families, which contribute to the generations, who by the reactions of their various potentialities, shape the history of the people! The fundamental question which we eugenicists have to deal with, is, therefore, one that concerns mainly our potential capabilities, their character and the degree in which they are distributed in our population. The question has to be put—however unpleasant and however inconsistent with the prevalent democratic notions—how have these inherent potentialities been affected by miscegenation with the more primitive races who constitute by no means a negligible percentage of the population of India? We must also ask—in what way have the various historical forces, operating through centuries, selected or eliminated the more or less desirable qualities of our population, so that they are to-day what they are! Is it possible, for example, that the nobler and more altruistic characters have been eliminated in course of age-long conflict with foreign conquerors, *e.g.*, Saks, Huns and others? Is it possible that hereditary defects of body and mind have accumulated in the population owing to lack of caution in sexual selection and, in general, a heedless attitude on questions of racial hygiene? Ten years ago we began asking ourselves these questions, and we have never ceased asking them!

The answer to such questions depended obviously upon our ability to undertake expensive research work, multifarious in nature and embracing a vast tract of country. This we were not in a position to undertake. For the first four years of the decennium all that we could do was to write short articles in the Bengali press, in an attempt to popularize the different aspects of eugenics and problems of heredity.

The later part of the decennium, however, found some of us in Europe, where eugenic ideas are more or less popular and eugenic laws are in actual operation in certain countries. From the results of the operation of the eugenic laws and state measures—calculated to improve the stocks in question—in Europe, we keenly felt the need to found this society, which, we hope, may some day inaugurate a powerful eugenic movement in this country.

### MADRAS MEDICAL COUNCIL

REGISTERED medical practitioners who own registration certificates with the number given below are requested to forward their certificates without delay to the Registrar, Madras Medical Council, 79-81, Mount Road, Cathedral P. O., Madras, for verification and return, as the records referring to these numbers are not traceable in the office. If no reply is received by the 15th March, 1942, it would be taken for granted that

registration certificates bearing these numbers were not issued at all:—

5178; 5189; 5190; 5193; 5194; 5195; 5196; 5197; 5198; 5203; 5204; 5205; 5206; 5207; 5208; 6427.

Registrar,  
Madras Medical Council.

### YELLOW FEVER DANGER TO INDIA

THE danger to India of the introduction of yellow fever considerably increased with the outbreak of the war. Necessary defensive measures have been planned which have so far kept India free from this danger.

Among the measures taken was the promulgation of the Indian Aircraft (Public Health) Emergency Rules, which laid down that no yellow fever-infected aircraft should land, on entry into India, at any other place than Karachi Air Port in the case of land planes and Karachi Marine Air Port in the case of sea-planes. They also provided for the isolation and observation in the mosquito-proof isolation hospital of persons suffering from or suspected to be suffering from yellow fever as well as of un inoculated persons who had been exposed to infection. Measures against the introduction of yellow fever by sea traffic are under consideration.

Sufficient stocks of yellow fever vaccine for inoculation have been obtained from the Rockefeller Foundation of New York and the Wellcome Bureau, London. They are kept in cold storage at the Central Research Institute, Kasauli, the Haffkine Institute, Bombay, the King Institute, Guindy, the Provincial Public Health Laboratory, New Delhi, and at the School of Tropical Medicine, Calcutta, and facilities for inoculation now exist in these places.

In the event of yellow fever being introduced into India and sufficient stocks of vaccines not being available for New York or London, the necessity of manufacturing the vaccine in this country has been noted. Arrangements have been made to send an experienced officer of the Medical Research Department to the United States for training under the Rockefeller Foundation in the manufacture of this vaccine.

Inoculations have been done at Delhi of officers and staff of the Government of India who would have to deal with a yellow fever outbreak and it has been decided to inoculate those persons at the ports of Bombay and Karachi who are likely to have dealings with a ship or aircraft infected with yellow fever.

### STEPS TO PREVENT MILK ADULTERATION

BOTH from economic and public health points of view, the Indian dairy industry is of considerable importance to the country and deserves a lot more attention than it has received in the past. This conclusion is stressed by the Agricultural Marketing Adviser to the Government of India, in summarizing his recommendations in an abridged edition of his Report on the Marketing of Milk in India and Burma.

This abridged edition has been published to aid producers, consumers and those interested in social or economic uplift to appreciate problems relating to the supply and distribution of milk.

To a people whose diet is deficient in first-class proteins, milk is vitally important, because it furnishes these proteins. The Agricultural Marketing Adviser urges the need to stimulate the consumption of fluid milk, for in this way all the nutritive constituents of milk are best assimilated. In order to stop the adulteration with imported skimmed milk powder the Report proposes the levy of a prohibitive import duty on this product; revision of the present standards of purity, which are very lax; the abolition of 'mixed' standards, and more vigilant enforcement of the Food Adulteration Acts by municipal authorities.

A scheme is suggested for the reorganization of milk distribution and marketing in towns and cities, by the

creation of a form of an authorized marketing organization, which would protect the interests of producers, distributors and consumers.

### OCCUPATIONAL THERAPY

LONDON doctors are to-day prescribing embroidery for soldiers with nervous trouble.

Knitting, explains Lady Smith-Dorrien, head of the Royal School of Needlework, is not enough to take the mind off worry.

Many women have written to her complaining that they have knitted and knitted until they can knit no longer and asking her for the best work to take up the entire attention.

To all of them Lady Smith-Dorrien recommends fine embroidery, intricate and difficult work which wholly occupies the mind.

The same principle is now being applied to the new methods in Britain's war-time hospitals. Mere amusement is not enough: the patient must be given an occupation that is difficult. Thus the needle, so long employed for putting something into him, is now being used, and with excellent results, in getting his worries out.

The Queen is so interested in the departure that when she found a soldier embroidering his regimental badge in a Red Cross hospital she asked for a sample of his work.

### DEVELOPMENT OF NURSING SERVICE IN INDIA

A SURVEY of nursing in India is to be carried out by means of a questionnaire issued to government departments, local authorities, voluntary hospitals, organizations of various kinds and to individuals interested in the training and conditions of service of nurses.

This survey will provide much valuable information on which to base recommendations for the development of a sound nursing service in India.

The number of registered nurses in India is approximately 5,000 against a total of 40,000 registered doctors. It is felt that a reversed proportion of nurses and doctors would be more in keeping with the duties which each profession has to perform.

#### Shortage of staff

One of the reasons why more hospitals in India do not train nurses is the shortage of an adequately qualified administrative and teaching staff. Rapid progress can only be made if facilities for post-graduate study are provided in India for nurses who have shown special ability and aptitude for administrative or teaching posts.

While the proposal has the general support of provincial medical departments and various non-official nursing and medical organizations, the extent to which provincial governments will be prepared to support the school by sending students for training and later by absorbing them into their nursing services is still to be explored. This information when obtained will be of the greatest help in formulating concrete proposals for the establishment of an All-India Post-Graduate Nursing School.

In order to secure uniformity of aims and standards throughout India and to facilitate inter-provincial reciprocity in the recognition and registration of nursing certificates, the establishment of a Central Nursing Council has been recommended by the Central Advisory Board of Health.

### THERAPEUTIC RESEARCH CORPORATION OF GREAT BRITAIN, LTD.

THE formation of the T.R.C. constitutes the most important step yet taken in the rationalization of the

British Fine Chemical industry. It is the rationalization of research in matters of common interest; in other words, truly basic rationalization to which will be added in due course, where desirable, a further measure of rationalization of production facilities compatible with national security.

It must be emphasized that the T.R.C. is *not* a merger or amalgamation of the companies concerned, each of which retains complete freedom of action in its special fields and, while contributing to a common research pool, forfeits none of its special characteristics.

Each of the five companies now participating in a joint scheme of research has over a long period of time carried out extensive scientific research which has been of great value to humanity. This work has, however, been conducted on individualistic lines which will not apply to work undertaken by the corporation. Any new drugs which may be discovered by the corporation will not be monopolized by any one company.

Many possible advantages of this new collaboration to medical science, as well as to the British pharmaceutical industry, can be readily foreseen. Increasing specialization of scientific technique tends more and more to call for men with long experience in particular methods; it also often calls for complicated and expensive equipment for its execution. The rapidly advancing volume of knowledge concerning the varied aspects of disease is now so great that to attain a full grasp of any one problem calls for a team of specialists in order that knowledge in these fields may be further extended. These may be accounted among the many advantages that may result from this scheme of co-ordinated research and unified effort in the exploration and solution of selected problems. Greater thoroughness and higher speed of investigation should result and much wasteful overlap should be eliminated.

There has existed in the past a diffidence on the part of some academic research workers in this country to ally themselves wholeheartedly with the researches of industrial firms. The seeds of such an alliance have nevertheless been sown during the past decade. The new corporation should be able to achieve much in fertilizing this growth by further breaking down the barriers and by establishing closer liaison between industry and the research laboratories of the universities.

Clearly, the corporation will have in the various chemical, physiological and bacteriological laboratories at their command the choice of many different lines of approach to their problems and the call on the extensive scientific personnel and equipment of the five companies. This should make for a hopeful start and lay the foundation of a promising superstructure.

The five companies concerned in this research corporation are:—

Boots Pure Drug Company, Limited.  
The British Drug Houses Limited.  
Glaxo Laboratories Limited.  
May and Baker Limited.  
The Wellcome Foundation Limited.

### MESSING OF BRITISH AND INDIAN TROOPS INCREASE IN ALLOWANCE

AN increase in the messing allowance of both British and Indian troops was made in 1940.

With the increase in the messing allowance for British troops, a great majority of the British units have been able to provide an excellent and ample dietary for their personnel without making any charge for extra messing. Messing was maintained at a satisfactory level in spite of rising prices of imported foodstuffs. The present rations *plus* the commuted rations and the messing allowance are considered quite sufficient to provide the soldier with an attractive diet of adequate caloric value.

The messing allowance for Indian troops has been increased to Rs. 2 per mensem. It is calculated that

in a well-organized unit the daily nett value of the food eaten by an Indian sepoy is now over 3,500 calories.

The issue of a pint of milk daily to each recruit of training battalions and similar units, at least for the first month of training, is under consideration.

### HEALTH OF CIVIL POPULATION

IMPORTANT problems relating to the health of the civil population were discussed at the fourth meeting of the Central Advisory Board of Health held in Calcutta on 26th, 27th and 28th January, 1942. The Hon'ble Mr. N. R. Sarkar, Member for Education, Health and Lands, Government of India, presided.

Two important subjects discussed at the meeting were the reports of two special committees on 'Leprosy and its control in India' and 'Medical Inspection of school children and the teaching of hygiene in schools'. The Board commented on the reports and made suitable recommendations.

Among other subjects discussed at the meeting were the control of cholera epidemics, provision of rural water supplies, the formation of an All-India Nursing Council and the provision of post-graduate training for nurses and the control of malaria in rural areas.

#### *Anti-leprosy work*

The Board, in commending the report on leprosy and its control for detailed consideration by Provincial and State Governments, expressed the hope that the recommendations would materially assist the Governments in the formulation and execution of a co-ordinated policy for anti-leprosy work, with special emphasis on the preventive aspect of the problem.

Any real progress in anti-leprosy work, it was stated, would require the co-operation of the public and particularly of medical men. For this a more enlightened attitude to leprosy and those suffering from it was essential. The Board recommended that wide publicity should be given to the report in the Provinces and States, preferably in the languages spoken by the peoples.

#### *Anti-cholera work*

Research carried out by the Indian Research Fund Association has established that cholera infection is permanently present only in certain restricted areas and that it spreads from such areas into other parts of India. The Board, therefore, suggested that a concentrated scheme of sanitary improvements in these endemic areas of cholera should prove to be the most effective method of controlling the spread of the disease. The provision of safe water supplies and an improvement of conservancy to prevent fly breeding are the most important steps to be undertaken by the health authorities.

### COCAINÆ HYDROCHLORIDUM

OWING to the extreme difficulty in obtaining supplies of cocaine hydrochloridum it is imperative that stocks in hand should be conserved to the utmost possible extent. This drug is imported in the crude state from South America to the United Kingdom where it is refined and despatched overseas. The purchase of cocaine involves therefore much foreign exchange.

### ATROPINÆ SULPHAS

OWING to the extreme difficulty in obtaining supplies of atropinæ sulphas it is imperative that stocks of this drug should be conserved to the utmost possible extent. As far as possible its use should be restricted to ophthalmic practice and replaced by tinctura belladonnæ, B.P., wherever practicable.

## Public Health Section

### A STUDY OF REGISTRATION OF BIRTH AND ITS UTILIZATION FOR PUBLIC HEALTH ADMINISTRATION IN MATERNITY AND CHILD WELFARE

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and

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THE All-India Institute of Hygiene and Public Health, Calcutta, maintains a maternity and child-welfare centre with the object of serving an area, roughly, the northern half of Ward VIII of the city, bounded by College Street on the east, Colootola Street on the south, Chitpur Road on the west, and the Mechua-bazar Street on the north. The population of the area is cosmopolitan and is drawn from various parts of India. As judged by the antenatal cases on cards during 1940, the representatives from Bombay Presidency, Rajputana, the Punjab, Bihar and Bengal predominate, their contributions being 19, 17, 15, 15 and 14 per cent, respectively.

Since the inception of the centre in 1933, as a routine procedure, records have been maintained of all infants known to have been born to parents resident in the area and in this paper a part of these records has been utilized to discuss some important problems connected with child-welfare organization.

The aim of a community programme is to contact all infants born in the area shortly after birth and it is recognized that the value of infant-welfare work is greatly reduced if contact with the infant cannot be established within 48 hours of birth. Under the existing procedure at the centre, infants are contacted either through the clinic, the delivery service, the home visiting routines, or by intimation of registration of birth by the registrar of the area. In many countries, contact is effected by enforcing early notification of birth (compulsory within 36 hours in England) to the health authorities, who immediately communicate the information to the visiting health staff concerned. In Calcutta, no such procedure exists, except in the case of maternity institutions, and registration of birth is the only procedure providing official intimation of birth.

The present investigation was undertaken to ascertain how far registration of birth alone can serve the purpose of notification, and, in the main, the discussion relates to :—

- (1) The completeness of registration of birth.
- (2) The possibility of utilizing registration for early contact.

### *Registration of birth*

On special request, since 1934, the health officer in charge of District II has been supplying once or twice a week, and occasionally at somewhat longer intervals, a list of births registered at the Bagla and Medical College registration offices. Since it is the practice of the Corporation to encourage parents to register births in the registration office serving the ward in which the birth took place, these lists should contain the registered births which occurred to residents in the centre area either at their residence or in institutions situated in the wards served by the two registration offices.

The records of the centre for the four-year period 1936-39 and the list of registered births from the municipal health authorities for the same period were utilized for this study. When the investigation was started it was found that the list of registered births for the year 1936 had been destroyed. With the kind permission of the chief health officer, Calcutta Corporation, copies were made from the records for that year, in the district health office.

To estimate the proportion of births registered, it is necessary to compare the number of registered births with the total number of births. Though, as stated above, only births occurring in the wards served by the registration office should be registered in that office, there is a tendency to effect registration in the office serving the place of residence of the parents. Hence, to obtain a correct picture of the present state of registration, it has been found necessary to divide the known births into three categories :

- (1) those which according to place of birth or place of residence of the parents cannot have been registered except in Bagla and Medical College registration offices,
- (2) those which occurred in institutions situated in wards not served by the above registration offices, and
- (3) those which, due to incompleteness of records, cannot be placed in either of the above groups. (A few births at residences outside the area are also included in this category.)

As there is a time lag between birth and registration, some infants born at the end of the year are registered in the succeeding year. To obtain an estimate of the proportion of registration of births in the different years, it was found essential to pair each registered birth with one in the list of known births compiled at the centre. This was all the more necessary as a preliminary scrutiny of the lists revealed discrepancies in regard to the particulars of registration and it was considered useful to make a note of these.

The number of known births and of those registered in the different years in each of the categories mentioned above, are as follows :—

| Year     | CATEGORY I<br>Born in the registration area |                   | CATEGORY II<br>Born outside registration area (institutional) |                   | CATEGORY III<br>Place of birth not known |                   | TOTAL        |                   |
|----------|---|-------------------|---|-------------------|--|-------------------|--------------|-------------------|
|          | Known births                                | Registered births | Known births  | Registered births | Known births                             | Registered births | Known births | Registered births |
| 1936 ..  | 416   | 222               | 21  | 2                 | 19                                       | 6                 | 456          | 230               |
| 1937 ..  | 420   | 249               | 31  | 2                 | 12                                       | 2                 | 463          | 253               |
| 1938 ..  | 451   | 331               | 40  | 4                 | 16                                       | 5                 | 507          | 340               |
| 1939 ..  | 304   | 194               | 33  | 3                 | 12                                       | 4                 | 349          | 201               |
| TOTAL .. | 1,591                                       | 996               | 125   | 11                | 59                                       | 17                | 1,775        | 1,024             |

There was a considerable decrease in the number of known births in 1939 which was due largely to many families, especially Marwaris and Gujrathis, having left for their homes just prior to the declaration of War.

The data in the three categories are of varying interest. The known births in the first category should have been registered in the two registration offices supplying the lists of registered births and the data in that category really provide a proper basis for studying the proportion of registration. The figures in the second category show how far the procedure of registering birth according to the place of birth is violated. Although the births in the second and third categories are not useful for estimating the percentage of total registration, the information supplied by these registered births can be used to assess registration as a means of early infant contact.

Since, as already stated, intimation of registration is at present used as one of the means of contacting infants, it is possible that some of the known births would not have come to the knowledge of the centre staff but for this agency. A comparison of the number of registered births with the number of known births is therefore likely to overestimate the proportion of registration.

The percentage of registration of births occurring in the registration area was 53.4 in 1936, 59.3 in 1937, 73.4 in 1938, and 63.8 in 1939. These percentages differ significantly. During 1936-37 the percentage of registration remained sensibly constant but in 1938 there was a significant increase. In 1939 the percentage fell but was still higher than that during 1936-37. During the four-year period under study 62.6 per cent of known births were registered.

As mentioned above, estimates of the percentage of registration made on the basis of known births exaggerate the figure in favour of registration; it therefore follows that, at most, only 63 per cent of births in the area were registered. Such a state of affairs is far from

satisfactory if registration is to be used as the sole means of contacting infants.

Various causes no doubt contribute to the poor registration of births and, if the more important

of these are detected, it will make the task easier for the authorities to improve registration figures. For this reason, the effect of certain factors on the percentage of registration was studied. These factors are: (1) the community of the parents, (2) the place of delivery, (3) the agency of delivery, (4) the civic status of the father, and (5) the sex of the infant.

*Community.*—During the four-year period, except for one birth in 1936, all the known births in the registration area were amongst Hindus and Moslems. The table below gives the number of known births and the percentage of registration for each of these communities :—

| Year     | Community  | Known births | Registered births | Percentage of registration |
|----------|------------|--------------|-------------------|----------------------------|
| 1936     | Hindus ..  | 233          | 118               | 50.6                       |
|          | Moslems .. | 182          | 104               | 57.1                       |
| 1937     | Hindus ..  | 228          | 128               | 56.1                       |
|          | Moslems .. | 192          | 121               | 63.0                       |
| 1938     | Hindus ..  | 256          | 176               | 68.7                       |
|          | Moslems .. | 195          | 155               | 79.5                       |
| 1939     | Hindus ..  | 171          | 98                | 57.3                       |
|          | Moslems .. | 133          | 96                | 72.2                       |
| TOTAL .. |            | 1,590        | 996               | ..                         |

In all the four years, the percentage of registration was higher amongst the Moslems and significantly so in 1938 and 1939. Although for the whole population the registration in 1939 was poorer than in 1938, the Moslem percentage in these two years was not significantly different, the average value being 76.5. This value is significantly higher than the corresponding one for the years 1936-37, which was only 60.2.

The Hindu percentage of registration also increased in 1938 but fell in 1939 to the level of 1936 and 1937. The percentage of registration in 1938 was 68.7 while the average for the other three years was 54.4.

There was thus an increase in the percentage of registration both amongst the Hindus and the Moslems in 1938 but in 1939 the latter only maintained the improved standard. The increase in 1938 over that of 1936-37 was proportionately the same for the Moslems as for the Hindus.

*Place of birth.*—A statement of all known births according to the place of birth, whether at residence or in an institution, is given below :—

|                 | 1936       | 1937       | 1938       | 1939       | TOTAL        |
|-----------------|------------|------------|------------|------------|--------------|
| Institution     | 70         | 66         | 83         | 68         | 287          |
| Residence ..    | 378        | 392        | 411        | 272        | 1,453        |
| Unknown ..      | 8          | 5          | 13         | 9          | 35           |
| <b>TOTAL ..</b> | <b>456</b> | <b>463</b> | <b>507</b> | <b>349</b> | <b>1,775</b> |

The great majority of births took place in private houses. In the four years considered, only 16.5 per cent of known deliveries were institutional.

The percentage of registration, as effected by place of birth, can be seen from the following figures for known births in the registration area.

It is remarkable that most of the births in institutions went unregistered; whereas nearly 68.1 per cent of births in private houses were registered, the corresponding figure for institutions was only 4.3 per cent. The fact that notification of birth, which is effected in all maternity institutions recognized by the Calcutta Corporation, is by a great proportion of the public mistaken for registration, probably explains the low proportion of registration of institutional births.

If all the births in institutions had been registered in the period under study, the percentage of registration would have been 62.3 in 1936, 65.5 in 1937, 81.6 in 1938 and 74.3 in 1939. It is obvious that steps taken to effect total registration of institutional births would alone increase considerably the proportion of registration.

From the table given below, it is clear that Hindus utilize institutional facilities to a much greater extent than do Muslims, so that the poorer registration of institutional births operates more upon Hindu registration.

It was therefore decided to compare the proportion of registration by communities, for domiciliary births only. The figures over page give the known and registered births occurring at residence within the registration area.

|                 | 1936       |            |            | 1937       |            |            | 1938       |            |            | 1939       |            |            | TOTAL      |              |            |
|-----------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|--------------|------------|
|                 | Registered | Total      | Percentage | Registered | Total      | Percentage | Registered | Total      | Percentage | Registered | Total      | Percentage | Registered | Total        | Percentage |
| Institution ..  | 1          | 38         | 2.6        | 2          | 28         | 7.1        | 3          | 40         | 7.5        | ..         | 32         | 0.0        | 6          | 138          | 4.3        |
| Residence ..    | 221        | 378        | 58.5       | 247        | 392        | 63.0       | 328        | 411        | 79.8       | 194        | 272        | 71.3       | 990        | 1,453        | 68.1       |
| <b>TOTAL ..</b> | <b>222</b> | <b>416</b> | <b>..</b>  | <b>249</b> | <b>420</b> | <b>..</b>  | <b>331</b> | <b>451</b> | <b>..</b>  | <b>194</b> | <b>304</b> | <b>..</b>  | <b>996</b> | <b>1,591</b> | <b>..</b>  |

|                 | 1936       |            |            | 1937       |            |            | 1938       |            |            | 1939       |            |            | TOTAL        |              |            |
|-----------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|--------------|--------------|------------|
|                 | Residence  | Total      | Percentage | Residence  | Total      | Percentage | Residence  | Total      | Percentage | Residence  | Total      | Percentage | Residence    | Total        | Percentage |
| Hindus ..       | 202        | 233        | 86.7       | 205        | 228        | 89.9       | 223        | 256        | 87.1       | 144        | 171        | 84.2       | 774          | 888          | 87.2       |
| Moslems ..      | 175        | 182        | 96.2       | 187        | 192        | 97.4       | 188        | 195        | 96.4       | 128        | 133        | 96.2       | 678          | 702          | 96.6       |
| <b>TOTAL ..</b> | <b>377</b> | <b>415</b> | <b>..</b>  | <b>392</b> | <b>420</b> | <b>..</b>  | <b>411</b> | <b>451</b> | <b>..</b>  | <b>272</b> | <b>304</b> | <b>..</b>  | <b>1,452</b> | <b>1,590</b> | <b>..</b>  |



*Births at residence*

|            | 1936       |       |            | 1937       |       |            | 1938       |       |            | 1939       |       |            | TOTAL      |       |            |
|------------|------------|-------|------------|------------|-------|------------|------------|-------|------------|------------|-------|------------|------------|-------|------------|
|            | Registered | Total | Percentage | Registered | Total | Percentage | Registered | Total | Percentage | Registered | Total | Percentage | Registered | Total | Percentage |
| Hindus ..  | 118        | 202   | 58.4       | 126        | 205   | 61.5       | 173        | 223   | 77.6       | 98         | 144   | 68.1       | 515        | 774   | 66.5       |
| Moslems .. | 103        | 175   | 58.9       | 121        | 187   | 64.7       | 155        | 188   | 82.4       | 96         | 128   | 75.0       | 475        | 678   | 70.1       |
| TOTAL ..   | 221        | 377   | ..         | 247        | 392   | ..         | 328        | 411   | ..         | 194        | 272   | ..         | 990        | 1,452 | ..         |

Although the higher proportion of registration by Moslems in all the years was maintained, the difference in each year between the communities was not statistically significant, indicating that the difference originally observed was due to the influence of institutional births.

*Agency of delivery.*—There is no great disparity in the proportion of registration according to the agency of delivery, be it doctor, midwife or *dai*. For the four-year period 1936–39 the percentage of registration amongst births delivered by doctors was 63.0; the corresponding figures for deliveries by midwives and *dais* were 69.9 and 68.1 per cent, respectively, as can be seen from the figures for deliveries at residence given below :—

*Schedule*

| Category | Occupations included in each category                    |
|----------|--|
| I        | Labourer, beggar, sweeper, coolie.                       |
| II       | Fruit seller, mason, bricklayer, shop assistant.         |
| III      | Shop-owner, master tailor, cloth merchant, motor driver. |
| IV       | Broker, businessman, student, lawyer, doctor.            |

Considering births in the registration area, information regarding the occupation of the male parent was available in 985 instances only. Of these 729 were registered. Although in most of the 996 registered births, the occupation was

|               | 1936       |       |            | 1937       |       |            | 1938       |       |            | 1939       |       |            | TOTAL      |       |            |
|---------------|------------|-------|------------|------------|-------|------------|------------|-------|------------|------------|-------|------------|------------|-------|------------|
|               | Registered | Total | Percentage | Registered | Total | Percentage | Registered | Total | Percentage | Registered | Total | Percentage | Registered | Total | Percentage |
| Doctor ..     | 8          | 15    | 53.3       | 3          | 11    | 27.3       | 16         | 19    | 84.2       | 7          | 9     | 77.8       | 34         | 54    | 63.0       |
| Midwife ..    | 40         | 74    | 54.1       | 77         | 114   | 67.5       | 100        | 125   | 80.0       | 60         | 83    | 72.3       | 277        | 396   | 69.9       |
| <i>Dai</i> .. | 171        | 282   | 60.6       | 157        | 252   | 62.3       | 195        | 243   | 80.2       | 123        | 171   | 71.9       | 646        | 948   | 68.1       |
| Others ..     | 2          | 7     | 28.6       | 10         | 15    | 66.7       | 17         | 24    | 70.8       | 4          | 9     | 44.4       | 33         | 55    | 60.0       |
| TOTAL ..      | 221        | 378   | ..         | 247        | 392   | ..         | 328        | 411   | ..         | 194        | 272   | ..         | 990        | 1,453 | ..         |

Since those in comparatively well-placed circumstances tend to summon a doctor or midwife for delivery, the question arose whether all sections of the community are not equally negligent in regard to registration. To obtain more precise information on this point, all births were classified according to the degree of civic sense to be expected from the father and the proportions of registration in the different classes compared.

*Civic sense of the male parent.*—The occupation of the male parent was used as the basis for estimating civic sense and on this basis infants were divided into four groups. The following schedule gives a list of some of the occupations included in each group :—

noted on the registration form, the information in the centre records was utilized so as to avoid an undue bias in favour of registration.

The numbers of registered and known births in the different categories are as follows :—

*Category*

|                   | I  | II  | III | IV  | TOTAL |
|-------------------|----|-----|-----|-----|-------|
| Registered ..     | 59 | 163 | 171 | 336 | 729   |
| Not registered .. | 13 | 50  | 48  | 145 | 256   |
| TOTAL ..          | 72 | 213 | 219 | 481 | 985   |

There is a significant difference in the proportion of registration in the different categories and surprisingly this is due to poorer registration in category IV. As parents in category IV are more likely to have the delivery conducted in an institution, it is possible that this factor has tended to lower the percentage of registration in this class. Out of the 70 births occurring in institutions within the registration area, 65.7 per cent belonged to category IV, 20.0 per cent to category III, 11.4 per cent to category II and 2.9 per cent to category I. Confining attention only to the births at residence for the four categories, the figures for registration are as follows :—

|                   |  | Category |     |     |     |       |
|-------------------|--|----------|-----|-----|-----|-------|
|                   |  | I        | II  | III | IV  | TOTAL |
| Registered ..     |  | 59       | 163 | 169 | 333 | 724   |
| Not registered .. |  | 11       | 42  | 36  | 102 | 191   |
| TOTAL ..          |  | 70       | 205 | 205 | 435 | 915   |

No significant difference exists in the percentage of registration of residential births for the four categories.

*Sex of infant.*—In order to ascertain whether factors such as legal inheritance and descent favour better registration of one of the sexes, the data available were utilized to elicit any difference in the percentages of registration of male and female infants.

births for Hindus and Moslems are given below :—

|             | MALE       |       |            | FEMALE     |       |            |
|-------------|------------|-------|------------|------------|-------|------------|
|             | Registered | Total | Percentage | Registered | Total | Percentage |
| 1936 Hindus | 61         | 121   | 50.4       | 57         | 108   | 52.8       |
| Moslems     | 48         | 89    | 53.9       | 56         | 90    | 62.2       |
| 1937 Hindus | 66         | 126   | 52.4       | 62         | 101   | 61.4       |
| Moslems     | 62         | 93    | 66.7       | 59         | 99    | 59.6       |
| 1938 Hindus | 89         | 129   | 69.0       | 87         | 127   | 68.5       |
| Moslems     | 92         | 119   | 77.3       | 63         | 76    | 82.9       |
| 1939 Hindus | 53         | 88    | 60.2       | 45         | 83    | 54.2       |
| Moslems     | 40         | 60    | 66.7       | 56         | 73    | 76.7       |

There is no significant difference in registration between males and females for either community and the higher percentage of registration in the case of Moslems applies equally to both sexes.

*Interval between birth and registration.*—According to the Calcutta Municipal Act of 1923, birth has to be registered within 8 days of occurrence, and it was sought to ascertain to what extent the general public is aware of this requirement, by considering the proportion of registrations actually effected within this period.

The interval between birth and registration was divided into six sections, *viz*, an interval of 24 hours, of 8 days, of 2 weeks, of 3 weeks, of 4 weeks and of over 4 weeks. The number of registrations effected in each interval irrespective of the area in which the births took place is given below :—

*Interval between birth and registration*

|         |          | Year | 24 hours | — 8 days | — 2 weeks | — 3 weeks | — 4 weeks | Over 4 weeks | TOTAL |
|---------|----------|------|----------|----------|-----------|-----------|-----------|--------------|-------|
| Hindus  | 1936 ..  |      | 4        | 51       | 26        | 14        | 7         | 21           | 123   |
|         | 1937 ..  |      | 12       | 50       | 28        | 7         | 5         | 29           |       |
|         | 1938 ..  |      | 8        | 67       | 26        | 13        | 9         | 59           |       |
|         | 1939 ..  |      | 20       | 43       | 15        | 7         | 3         | 13           |       |
|         | TOTAL .. |      | 44       | 211      | 95        | 41        | 24        | 122          |       |
| Moslems | 1936 ..  |      | 2        | 62       | 18        | 9         | 3         | 13           | 107   |
|         | 1937 ..  |      | 5        | 56       | 18        | 10        | 5         | 28           |       |
|         | 1938 ..  |      | 9        | 67       | 29        | 12        | 10        | 31           |       |
|         | 1939 ..  |      | 7        | 51       | 14        | 11        | 4         | 13           |       |
|         | TOTAL .. |      | 23       | 236      | 79        | 42        | 22        | 85           |       |

In the case of four Hindu births and three Moslem births in 1936 and one Hindu birth in 1937 no information of the sex of the child was available. Naturally these were unregistered. The figures of registration of male and female

It may be mentioned that the date of birth, as given on the registration form, was in some cases different from that entered by the visiting staff. As the health visitor obtains her information at the residence and from the female

members of the household, it is more likely that her information is correct; the date of birth, as entered by the health visitor, was therefore used in estimating the interval.

In the case of Hindus, the proportion of cases falling into the different groups remained sensibly the same during the period 1936-38, the proportion within 8 days of birth being 44.0. In 1939, however, there was an improvement for earlier registration, 20 per cent of the registration taking place within 24 hours of birth and 62 per cent within 8 days.

In the Moslem community, no change for earlier or later registration was noticeable during the period under study; 4.7 per cent of the registrations took place within 24 hours and 53.2 per cent within 8 days. Considering only the proportion of total registration within 8 days, the Hindu figures were lower than those of the Moslems until 1939. In 1939 the Hindu percentage of registration within the legal period was equal to that of the Moslem community.

Although legally every birth in Calcutta must be registered within 8 days, it was to be expected that in the case of neonatal deaths registration would be poorer. The numbers of known infants alive for or known to have died within 8 days and the related percentages of registration are as follows:—

|      | LIVED FOR 8 DAYS |            |                            | DIED WITHIN 8 DAYS |            |                            |
|------|------------------|------------|----------------------------|--------------------|------------|----------------------------|
|      | Number           | Registered | Percentage of registration | Number             | Registered | Percentage of registration |
| 1936 | 431              | 225        | 52.2                       | 25                 | 5          | 20.0                       |
| 1937 | 435              | 249        | 57.2                       | 28                 | 4          | 14.3                       |
| 1938 | 477              | 324        | 67.9                       | 30                 | 16         | 53.3                       |
| 1939 | 337              | 192        | 57.0                       | 12                 | 9          | 75.0                       |

On the whole there was poorer registration of infants who died within 8 days.

Incidentally it may be pointed out that the number of infant deaths known to have occurred within 8 days, as shown by the above figures, remained constant during the four years, the rate being 53.5 per mille.

*Errors in registration.*—Not only is complete registration of birth desirable but it is necessary that the particulars supplied to the registrar should be accurate. Of the information contained in the form used in Calcutta for registration of birth, the sex of the child and the date of birth are more important from the point of view of the compilation of birth statistics, and as correct information on these points can be readily obtained by the visiting staff, it was proposed to assess errors in registration due to (1) error in sex, (2) error in date of birth.

Errors of type (1) were too few to receive any serious consideration; but during the four-year period under investigation, in 339 cases, constituting 33.1 per cent of the registered births, the

date of birth in the registration form was incorrect when compared with the information available at the centre. Figures for the Hindu and Moslem communities were as follows:—

|      |            | Number of registered births | Number with errors |
|------|------------|-----------------------------|--------------------|
| 1936 | Hindus ..  | 123                         | 31                 |
|      | Moslems .. | 107                         | 21                 |
| 1937 | Hindus ..  | 131                         | 34                 |
|      | Moslems .. | 122                         | 46                 |
| 1938 | Hindus ..  | 182                         | 59                 |
|      | Moslems .. | 158                         | 67                 |
| 1939 | Hindus ..  | 101                         | 32                 |
|      | Moslems .. | 100                         | 49                 |

Error in registering the date of birth is more frequent amongst Moslems.

The 339 cases were divided into five groups according as the interval between the date of birth as recorded by the centre staff and that on the registration form was less than 48 hours, less than a week, less than 2 weeks, less than 4 weeks, and over 4 weeks. The frequency of the different groups was as follows:—

| — 48 hours | — 1 week | — 2 weeks | — 4 weeks | Over 4 weeks |
|------------|----------|-----------|-----------|--------------|
| 134        | 97       | 30        | 27        | 51           |

In only 24 cases was there antedating of birth, and in none of these did the period exceed four weeks. Considering only the post-dated cases the number in the different groups fell as shown below:—

| — 48 hours | — 1 week | — 2 weeks | — 4 weeks | Over 4 weeks |
|------------|----------|-----------|-----------|--------------|
| 123        | 88       | 27        | 26        | 51           |

Since in a majority of cases the error was due to post-dating of the birth and since in a high proportion of post-dated cases the interval between the actual date of birth and the date as recorded exceeded one week, it may be asked whether post-dating was unintentional. One motive suggests itself; to avoid the penalty of late registration. A scrutiny of the figures, however, indicated that in a majority of instances, in spite of post-dating, the interval between notified date of birth and the date of registration exceeded the legal period of 8 days. As was to be expected, the longer the interval between birth and registration, the greater the interval between the actual and the recorded dates of birth.

#### *Registration in regard to Public Health Administration*

In the foregoing section, the civic implications of the present position of birth registration in Calcutta has been dealt with primarily. There

now remains to be discussed the bearing of these facts upon public-health administration, as it relates to the dependence of a welfare centre upon official intimation of birth (i.e., a registered birth in the case of Calcutta) for home contact with the new-born infant.

The death rate among infants is the highest in any population within the first month of birth. The aim of a modern community infant-welfare programme is to contact, shortly after birth, all infants born at residence in the area. It is recognized that the value of the programme is greatly reduced if a home visit cannot be paid within 48 hours of birth. Except in a few training or demonstration areas, in no country in the world is the size of the visiting health staff in routine community infant-welfare work based upon the assumption that all live births will be contacted within that period through centre routine procedures alone: some efficient form of official intimation of birth is essential.

Although it is not feasible at present to expect so rapid a home contact in an Indian urban area, the primary consideration in planning and assessing an infant-welfare programme should be the shortening of the interval between birth

other factors being favourable, not more than two-thirds of the births in the area *could* have been contacted in this way.

The factors which further influence utilization of registration for infant contact are three:— (i) the interval between birth and registration; (ii) the interval between registration and intimation to the centre; (iii) the interval between receipt of intimation at the centre and first visit to the home.

Under ideal conditions, these intervals in series would occupy not longer than 48 hours. This would entail registration within 24 hours of birth, an interval of not much more than an hour for intimation of registration to the centre, and an interval of less than 24 hours between receipt of the intimation and the time of the first visit to the home.

These intervals will now be discussed in regard to the registered births under investigation for each year of the study.

*Interval between birth and registration.*— Below is given a table showing the number and percentage of births at residence, which were registered within 24 hours, 8 days, 2 weeks, 3 weeks, 4 weeks and after 4 weeks from birth:—

*Interval between birth and registration at residence*

| Year | — 24 hours |          | — 8 days |          | — 2 weeks |          | — 3 weeks |          | — 4 weeks |          | Over 4 weeks |          | TOTAL |
|------|------------|----------|----------|----------|-----------|----------|-----------|----------|-----------|----------|--------------|----------|-------|
|      | Num-ber    | Per-cent | Num-ber  | Per-cent | Num-ber   | Per-cent | Num-ber   | Per-cent | Num-ber   | Per-cent | Num-ber      | Per-cent |       |
| 1936 | 6          | 2.7      | 110      | 49.8     | 43        | 19.5     | 21        | 9.5      | 8         | 3.6      | 33           | 14.9     | 221   |
| 1937 | 17         | 6.9      | 104      | 42.1     | 43        | 17.4     | 17        | 6.9      | 10        | 4.0      | 56           | 22.7     | 247   |
| 1938 | 15         | 4.6      | 131      | 39.9     | 52        | 15.9     | 25        | 7.6      | 19        | 5.8      | 86           | 26.2     | 328   |
| 1939 | 27         | 13.9     | 91       | 46.9     | 27        | 13.9     | 18        | 9.3      | 6         | 3.1      | 25           | 12.9     | 194   |
|      | 65         | ..       | 436      | ..       | 165       | ..       | 81        | ..       | 43        | ..       | 200          | ..       | 990   |

and the first home visit by the health visitor to the infant.

In Calcutta, for births at residence, the only authoritative procedure, which can be utilized for home contact, is registration of birth which by law must be effected within 8 days.

Despite the fact that rapidity of contact is the essence of health protection, and although it is recognized that registration under such circumstances is not an ideal procedure for the purpose, it is the one at present in use: it was, therefore, deemed advisable in this study to ascertain to what extent intimation of registration affected the interval between birth and first home visit.

In order that registration should function fully as an aid to public-health administration in this way, the first essential is that all births should be registered. It has been seen that in the area served by the Institute centre, the average percentage of registration of births at residence for 1936-39 was 68.1. only, so that

In 1936 2.7 per cent, in 1937 6.9 per cent, in 1938 4.6 per cent and in 1939 13.9 per cent of births at residence, therefore, fulfil the first condition, namely, that of registration within 24 hours of birth.

*Interval between registration and intimation to the centre staff*

In considering the relationship between rapidity of intimation and contact with the infant, the time interval between registration and receipt of notice by the centre staff was investigated; the interval was distributed as follows: less than 24 hours, less than 48 hours, less than 72 hours, less than one week and more than one week.

The table below shows the distribution of registered births, according to these intervals, for the years under review, with the exception of 1936, for which year the time of receipt of notice was not available, as the registration lists had been destroyed.

*Interval between registration and receipt of notice in the clinic*

| Year     | — 24 hours | — 48 hours | — 72 hours | — 1 week | Over 1 week | Total with known interval | Unknown | TOTAL |
|----------|------------|------------|------------|----------|-------------|---------------------------|---------|-------|
| 1937 ..  | 1          | 30         | 25         | 138      | 27          | 221                       | 32      | 253   |
| 1938 ..  | 1          | 36         | 51         | 205      | 43          | 336                       | 4       | 340   |
| 1939 ..  | 0          | 22         | 28         | 97       | 26          | 173                       | 28      | 201   |
| TOTAL .. | 2          | 88         | 104        | 440      | 96          | 730                       | 64      | 794   |

For those births with known interval, in only two cases out of 730 registered births was the interval between registration and receipt of notice in the centre less than 24 hours; in 88 cases, 12.1 per cent, the interval lay between 24-48 hours; in 104 cases, 14.2 per cent between 48-72 hours; in 440 cases, 60.3 per cent between 72 hours and one week, while in 96 cases, 13.1 per cent, the interval exceeded a week.

In the great majority of registered births the interval lay between 72 hours and one week, while in only 12 per cent was the interval less than 48 hours. During this three-year period no significant change occurred towards the shortening or lengthening of this interval, i.e., the proportions in the several groups remained unchanged from 1937-39.

*Interval between receipt of notice in the centre and first home visit*

When the routine service of a maternity and child-welfare centre includes delivery service, those infants delivered by the staff are necessarily contacted by the health visitor within 24 hours. In order to obviate this vitiation of the findings, in the table given below, only those births have been studied which were first contacted through registration.

The interval between receipt of notice and first home visit to the infant was divided into:—Under 24 hours, 24-48 hours, and exceeding 48 hours.

which occurred during 1939 in the proportion of contact made with the infant within 24 hours after receipt of notice.

Considering all three factors together, it is apparent that the interval between registration and intimation of birth (which has remained unchanged during the last three years of the study) is too long to permit of administrative procedures benefiting by the trend towards shortening of both the interval between birth and registration and that between receipt of notice and home contact, to the extent of increasing the proportion of contacts within 48 hours.

The fact that in only two cases was the interval less than 24 hours between registration and receipt of notice makes it very apparent that, unless this interval can, by some means, be shortened considerably, *contact within 48 hours of birth must be effected by centre procedures alone.*

*Infant contact*

Although contact within 48 hours of birth should be the aim, many factors operating upon urban infant-welfare work in this country make it essential at present to relax this requirement.

It was therefore sought to ascertain how far intimation of registration helped infant contact during these four years.

*Interval between receipt of information in the clinic and first visit*

|         | — 24 hours |          | — 48 hours |          | Over 48 hours |          | Total contacted through registration | Total contacted before registration | Total registered births |
|---------|------------|----------|------------|----------|---------------|----------|--------------------------------------|-------------------------------------|-------------------------|
|         | Number     | Per cent | Number     | Per cent | Number        | Per cent |                                      |                                     |                         |
| 1937 .. | 20         | 18.3     | 11         | 10.1     | 78            | 71.6     | 109                                  | 144                                 | 253                     |
| 1938 .. | 24         | 14.5     | 16         | 9.7      | 125           | 75.8     | 165                                  | 175                                 | 340                     |
| 1939 .. | 53         | 49.5     | 7          | 6.5      | 47            | 43.9     | 107                                  | 95                                  | 201                     |

It will be seen that while in 1937 and 1938 only 18.3 per cent and 14.5 per cent, respectively, of these registered births were visited within 24 hours of receipt of notice, in 1939 the figure was 49.5 per cent. These percentages differ significantly owing to the marked improvement

In the tables opposite is shown the number of infants born at residence (1) of those contacted through registration, (2) of those contacted by routine procedures, who were first visited within two weeks, within one month, within three months and later than three months, from birth.

In all the three years, except for two births, all infants contacted through registration were visited within three months of birth, while of

|                                   | Contacted through registration |          |           |               | Total |
|-----------------------------------|--------------------------------|----------|-----------|---------------|-------|
|                                   | -2 weeks                       | -1 month | -3 months | Over 3 months |       |
| 1937                              | 28                             | 52       | 26        | 1             | 107   |
| 1938                              | 44                             | 69       | 44        | 0             | 157   |
| 1939                              | 61                             | 32       | 11        | 1             | 105   |
| <i>* Contacted through visits</i> |                                |          |           |               |       |
| 1937                              | 89                             | 63       | 42        | 16            | 210   |
| 1938                              | 83                             | 49       | 33        | 6             | 171   |
| 1939                              | 49                             | 38       | 22        | 9             | 118   |

\* Excludes 75 cases in 1937, 83 cases in 1938 and 49 cases in 1939 delivered by the centre staff.

those contacted by routine procedures, 31 out of 499 were over three months of age when first visited. Since these 499 births include those visited prior to receipt of intimation of registration, it may be concluded that, in a fair proportion of unregistered infants, contact by routine procedures took place in the second trimester of life.

In 1939, apart from earlier registration, which has already been mentioned, the interval between receipt of intimation and the first home contact tended to decrease. In 49.5 per cent of cases contacted through registration this interval was less than 24 hours. The combined effect of these two factors was to increase the proportion of contacts through registration in the interval less than two weeks after birth. In the same year it is seen that the proportion of infants contacted within two weeks is significantly higher in the case of infants contacted through registration.

It therefore emerges that, in spite of the long interval between registration of birth and intimation to the centre, public health administration in infant welfare does benefit from utilization of registration returns although not as regards contact within 48 hours.

In 1939, although registration lists were received somewhat irregularly on an average four to five times a month, it was possible to contact, within 24 hours of receipt of notice, about 50 per cent of those births first heard of through registration. This occasionally necessitated contacting four births in a day, which is bound to effect some disturbance of routine duties. Reduction in the interval between registration and intimation to the health visitor would therefore lead to earlier contact in two ways: firstly, by providing an opportunity for contact immediately after registration, and, secondly, by helping to establish, through the receipt, more frequently and regularly, lists containing fewer births, an almost daily routine which would interfere very little with other duties.

However, even under ideal conditions, utilization of registration has a limited value. If it were decided to use registration for contact within 48 hours, the legal period of eight days would have to be shortened. The other alternative, and the more satisfactory one, would be to introduce a system of notification to the health authorities.

#### *Notification : Its utilization for infant contact and improvement of birth registration*

The system of notification which is envisaged is really an extension and modification of the existing system of notification in operation for births taking place in maternity institutions approved by the Calcutta Corporation and for those conducted by the Corporation domiciliary midwifery service.

By notification of birth is intended compulsory notification within 36 hours to the district health officer, or his deputed representative, of all births (including still-births) by the delivering agent (or professional attendant called in within a few hours of birth). Such a delivering agent might be a doctor, nurse, midwife or *dai*. The measure would embrace births occurring at residence or in an institution.

At the local office, a list of notified births would be compiled immediately in conformity with the districts served by the home-visiting child-welfare agencies, and this list despatched either by bicycle messenger to the centres or collected daily from the local office by a messenger from each centre. As voluntary organizations carrying on infant-welfare service are heavily subsidized from Corporation funds, and as notification would be introduced as a health measure primarily, and not one for the collection of vital statistics, no distinction between official and voluntary organizations should arise either as notifying agents or for access to lists of notified births. The lists would naturally be open to inspection by the Registrar of the area.

This procedure should permit of contact with the infant within three days of birth in the majority of cases and would enable the registrar to discharge the responsibility laid upon him under the Calcutta Municipal Act to effect registration of births not registered within eight days. It would further ensure that hospital births at present notified would be notified more promptly and would be included in the list of births prepared for the use of the home-visiting welfare workers.

The maternity service of the Corporation could also extend its facilities without further expenditure, as it would be relieved of infant-welfare service after the first 48 hours. Co-operation between the agencies working for infant welfare would be strengthened and the aims of the health service clarified.

Although free midwifery service by a certificated midwife may act as an impediment to complete co-operation at first, the difficulty of inducing the *dai* to act as a notifying agent



should not be great, provided the purpose for which information is needed is made clear, and provided centre staffs make contact with the *dais* in their districts. It has been shown that registration of births is not poorer in the case of delivery by *dais*, indicating that registration is not discouraged by them.

In the case of the trained midwife and the nurse, notification of birth is perhaps a natural corollary to registration under the Nursing Council Act.

#### *Summary and conclusions*

This study was undertaken with the object of ascertaining whether registration of births in its present legal aspect and as practised by the public in Calcutta could be utilized by an infant-welfare centre to make earlier contact with the infants born in the area it serves.

With this object the proportion of registration effected was estimated for infants born to parents resident in the area served by the maternity and child-welfare centre of the All-India Institute of Hygiene and Public Health, Calcutta, during the years 1936-39.

As the average percentage of registration for that period was 62.6, at the highest estimate, it was considered desirable to elicit, as far the data available permitted, the factors which might have brought about this deficiency.

An important factor was found to be the poorer registration of institutional births, which was 4.3 per cent against 68.1 per cent for births at residence. This is probably due to the public interpreting as registration the notification of births, which is compulsory in recognized maternity institutions in Calcutta. Muslim registration was throughout higher than Hindu registration and significantly so in 1938-39. This difference was shown to be due to the greater utilization of institutional facilities by the Hindu community.

Registration of births at residence did not appear to be influenced by the attendant at delivery, whether doctor, midwife, or *dai*: nor by the sex of the child.

Excluding the influence of institutionalization, registration was not found to vary with the sense of civic responsibility as judged by the occupation of the male parent.

Errors of registration were studied as they are of both statistical and administrative importance, particularly those related to the date of birth and the sex of the infant. It emerged that in approximately one-third of registered births, the date of birth differed from that noted in the centre register, the tendency being towards post-dating. The object did not appear to be to reduce the interval between birth and registration to the legal period of eight days. Errors in registration of the sex of the infant were negligible.

The utilization of registration of birth for rapid contact with the infant depends upon

- (1) the interval between birth and registration,

- (2) the interval between registration and receipt of notice in the centre,
- (3) the interval between receipt of notice and the first home visit by the health visitor.

Although there was a tendency towards earlier registration and also more rapid contact after receipt of intimation of registration, particularly in 1939, the interval between registration and intimation to the centre remained constant. During 1937-39 in 60.3 per cent of cases this interval lay between 72 hours and one week. This rendered intimation of registration ineffective for contact within 48 hours of birth.

Notice of registration was, however, found to influence favourably home contact within two weeks of birth. Under existing procedure in 1939 nearly half of the infants contacted through registration were visited within 24 hours of receipt of intimation. It is therefore concluded:

- (i) that if the interval between registration and receipt of intimation by the centre were appreciably reduced, considerable improvement in rapidity of contact would be possible, without dislocating the routine services of a maternity and child-welfare centre.
- (ii) that for registration of birth to be fully effective for contact within 48 hours of birth, not only should registration be complete, but also the legal period would have to be markedly reduced.
- (iii) that in view of the impracticability of shortening the legal period of registration, the introduction of compulsory notification of birth, as indicated in the text, is probably the better solution of the problem.

#### *Acknowledgment*

The authors wish to express their thanks to Dr. R. B. Lal for providing the schedules and cards for this enquiry, and to Dr. Muktha Sen for assistance in checking the births in the registration lists with those in the centre records.

## Reviews

**COMMON SKIN DISEASES.**—By A. C. Roxburgh, M.A., M.D., B.Ch. (Cantab.), F.R.C.P. (Lond.). Sixth Edition. 1941. H. K. Lewis and Company, Limited, London. Pp. xxxi plus 436, with 8 plates and 179 figures in the text. Price, 16s.

It is a pleasure once again to note the appearance of the sixth edition of this excellent small book on skin diseases. Since 1932, when the book first appeared, a new edition has come out regularly every second year. In every edition improvements and additions have been made, necessitated by advance in our knowledge of aetiology and improved methods of treatment that are introduced.

In the present edition some of the principal additions, among the many that have been made, are a note on the use of Thorium X, which affords a simple means of applying radiation treatment by means of an ointment or varnish, the aetiology of impetigo has been revised in view of the accepted fact that it may be streptococcal and/or staphylococcal in origin, and the newer

treatments for scabies and pediculosis have been included. Dermato-myositis has been added; until quite recently this disease has been regarded as so rare as to be more or less a curiosity, but a much larger number of cases have been reported in the past two or three years; the explanation is that in all probability it is not due to an increase in the disease but to a better knowledge of dermatology by the general practitioner, a possibility not unconnected with the publication of such books as the one we are reviewing.

We are pleased to see that the subject of avitaminosis has been revised and amplified, more particularly as we expressed the hope that this would be done, when we reviewed the fifth edition.

When we reviewed the second edition we noted the inevitable tendency to increase in length, compared with the first. This is a necessity if a subject is to be kept up to date and when one starts with bare necessities as the author did in his first edition it is not possible to balance additions by whittling down the old parts. We have not the early editions at hand at the moment, but the increase between the third and the sixth is only 56 pages. Therefore the author is to be congratulated on the manner he has met this difficult and essential aspect of regular republication of a book, namely keeping it up to date without making it a great deal larger.

It is remarkable that the publishers are still able to produce the book in exactly the same high class style and to make use of the same paper and bindings as they did in the pre-war editions.

P. A. M.

**AN INTRODUCTION TO MEDICAL SCIENCE.**—By William Boyd, M.D., M.R.C.P. (Edin.), F.R.C.P. (Lond.), Dipl. Psych., F.R.S. (Canada). Second Edition. 1941. Henry Kimpton, London. Pp. 358. Illustrated with 124 engravings. Price, 16s.

In his preface the author indicates that he has written the book for the probationer nurse to enable her to gain some general insight into her work, before she has acquired special knowledge from her courses of lectures.

It is an excellent book for this purpose but we would recommend it also to medical students at the beginning of their hospital work as we are sure they would find it of great value. The reviewer can still recollect his difficulty in gaining real comprehension of what he was doing and why he was doing it, until he had been attending the hospital for a considerable time. Such a book as this would have greatly shortened this period of uncertainty.

If we may offer a suggestion whereby this book could be improved we consider a small glossary would be a valuable addition. As an example, the novice would be at a loss to know what is meant on p. 45 where he is told that thrombosis occurs in the *auricles* of the heart and it is not until he reaches p. 131 that he finds an explanation, and again throughout the excellent summary of the pathogenic bacteria the distinctions 'Gram-positive' and 'Gram-negative' are repeatedly used without saying what they mean; other similar examples can be found. Apart from this minor defect, which can be easily rectified in the next edition, we have nothing but praise for the conception behind the book and for the manner in which the subject has been presented.

P. A. M.

**SYMPTOMS IN DIAGNOSIS.**—By Jonathan Campbell Meakins, M.D., LL.D. 1941. Little, Brown and Company, Boston. Pp. xxi plus 323. Illustrated.

In recent years there has been a tendency to give less importance to the interpretation of symptoms in the diagnosis of a disease than to the physical signs and/or laboratory findings. But it is the symptoms which bring the patient to the physician, and there are many diseases that have no particular signs. A good

history and a proper evaluation of complaints cannot therefore be underestimated. A typical case of coronary occlusion may be correctly diagnosed by listening to the patient's way of telling his story; it would be unfair to neglect this and rush for an electro-cardiographic tracing to recognize the condition, not without patient's discomfort and financial loss, although the value of the latter is undisputed. The modern advance of chemical, physical and physiological methods in clinical medicine should be utilized in the interpretation of symptoms, on a firmer foundation to-day than ever before.

Dr. Meakins has interpreted in this book the common symptoms in the light of recent scientific and clinical knowledge. It is divided into five sections. The first chapter deals with the physical characteristics of the body with reference to growth, stature, weight, obesity and emaciation, of which there is a good number of illustrations. Next, the cutaneous manifestations have been discussed, including the fundamental mechanism of cyanosis, oedema, etc. The subsequent chapters are on disturbances of sensation with special reference to various pains, symptoms of localizing value, mostly in connection with the gastro-intestinal and respiratory tract, and on symptoms having reference to general function, *viz*, fatigue, disorders of sleep and coma.

The book will prove useful to students and physicians in the practice of medicine.

R. C.

**ROENTGEN INTERPRETATION.**—By George W. Holmes, M.D., and Howard E. Ruggles, M.D. Sixth Edition. 1941. Henry Kimpton, London. Pp. 364. Illustrated with 246 engravings. Price, 24s.

OWING to the untimely death of Dr. Howard Ruggles the sixth edition of this well-known work on x-ray interpretation has been prepared by the co-author Dr. G. W. Holmes.

The subject-matter has been reviewed and brought up to date. Some illustrations have been replaced and new ones added. Recent important advances in roentgen diagnosis have been described and illustrated. No attempt has been made to change the general character of the book.

While there is no claim to cover the entire subject completely, there are few conditions which do not receive adequate treatment, the most notable exception being pregnancy and abnormalities of the foetus.

As an introduction to x-ray interpretation, however, and on account of its freedom from descriptions of apparatus and technique it makes a special appeal to the practising physician and surgeon.

For those requiring additional information on any of the subject-matter an extensive bibliography is provided at the end of each chapter.

The publishers are to be congratulated on the general appearance of the work, the clear type and excellent illustrations.

J. A. S.

**MEDICAL ELECTRICITY FOR MASSAGE STUDENTS.**—By Hugh Morris, M.D., D.M.R.E. Second Edition. 1941. J. and A. Churchill Limited, London. Pp. xiv plus 394, with 114 illustrations. Price, 18s.

A SECOND edition of this well-known work will be welcome to those who have read the first edition. As the author says this is really a new book. The contents of the first edition have been thoroughly revised and new chapters on diathermy and ultra-violet rays have been added. A number of new line diagrams have been included.

The early chapters are concerned entirely with physical problems and, though of an elementary character, give a clear and up-to-date outline of the subject.

The later chapters are equally praiseworthy, particularly the new chapters on diathermy and ultra-violet rays.

As it stands, it covers the course for the electrotherapy examination of the Chartered Society of Massage and Medical Gymnastics.

The publishers are to be congratulated on the attractive manner in which they have produced the book.

J. A. S.

**CHOLERA: ITS PREVENTION AND CURE.—By A. J. H. deMonte, Dp. Bact. (Manchester), I.M.D. 1941. Thacker, Spink and Company (1933), Limited, Calcutta. Pp. 60. Price, Re. 1**

The danger from cholera is ever present in India, in Bengal and Madras for practically the whole year round and in other parts of the country for a number of months each year.

It is therefore important that not only should doctors know how to prevent, diagnose and treat cholera, but

householders, and more especially those who are responsible for the health of larger bodies of people, such as managers of industrial concerns where much labour is employed, school masters, missionaries, etc., should learn how to recognize, and should be conversant with, at least the principles of prevention and cure of this dread disease.

The author, who has been attached to the School of Tropical Medicine for 11 years, and during the last 7 years has been in charge of the bowel disease research department, has had considerable practical experience in the treatment of cholera in the field and more recently at the Campbell Hospital in Calcutta.

This small booklet is particularly welcome, as it is written in a language which the layman can understand but which is yet scientific enough to give the doctor all the special instructions that he will require for treating this disease in the most efficient and up-to-date manner.

## Abstracts from Reports

### TWENTY-EIGHTH ANNUAL REPORT OF THE CHIEF ENGINEER, PUBLIC HEALTH DEPARTMENT, BENGAL, FOR THE YEAR ENDING DECEMBER 1940

THERE was steady progress of public health engineering works in the province during the year. Besides the permanent executive staff of one chief engineer, three executive engineers, three assistant engineers and one superintendent of waterworks, the department also maintained several temporary hands in the subordinate engineering establishment in order to cope with the work.

Fourteen works of sanitary engineering were executed under the supervision and control of the department. Besides, the department also continued to maintain the Baranagar-Kamarhati joint waterworks, the Kalimpong and the Maijdi waterworks as in the previous year.

The department rendered valuable assistance in the shape of advice and suggestions to other departments, local officers and local bodies in matters relating to works of sanitary engineering.

The Sanitary Board held only three meetings and considered seven sketch projects and eight detailed

projects, all of which except the detailed project regarding the Tollygunge Protective Embankment were approved and recommended to Government for sanction subject to certain conditions in regard to particular cases. The Board also considered a few anti-malaria schemes.

The malaria sub-committee of the Board prepared a draft of a Bengal Anti-Malaria Bill which was considered and approved by the Sanitary Board. A nutrition sub-committee of the Board was established during the year for the purpose of providing a co-ordinating body for the several local agencies undertaking activities in nutrition.

The proposal by the Director, All-India Institute of Hygiene and Public Health, for the establishment of a Nutrition Committee of the Board for the purpose of providing a Bengal co-ordinating body for the several local agencies undertaking activities in nutrition without any financial liability on the part of Government was considered and accepted by the Board. A committee with power to co-opt was accordingly constituted. A resolution to the effect that a new section on improvement of milk supply in Calcutta and other towns of Bengal be included in the programme of the Nutrition Committee was referred by the Board to the said committee for necessary action.

## Correspondence

### MINOR DRUG HABITS OF INDIA

SIR.—In part II of 'Minor Drug Habits' in your issue for February, under the heading of 'Chemistry of a Cup of Tea', on p. 109, no mention is made of theophyllin as being one of the constituents of tea. A little further disquisition on this alkaloid would be interesting; as Hale White's *Materia Medica*, twenty-third edition (the only book I have which mentions it), is rather sketchy. Older books don't mention it.

Theobromine is once or twice referred to, as if its composition and effects were the same as those of caffeine, which is hardly the case.

On p. 124 of your same issue, the use of ipecacuanha is deprecated (though some medical men approve of it) and para 2 opens with the remark that 'Ipecacuanha is not indigenous to India'. No; but *acalypha indica*

is, and its action is, said to equal that of ipecac. Is this true? What is its vernacular name?

G. F. ROWCROFT,  
Colonel.

COONOOR,  
27th February, 1942.

Note.—With reference to Colonel Rowcroft's letter, theophyllin has been isolated from tea in minute quantities. Its effect on the gastro-intestinal system is only produced when a person consumes large quantities of tea during the course of a day. But as the heading goes, in 'Chemistry of a Cup of Tea'—caffeine and tannin are the chief constituents on which the physiological effect depends.

Theophyllin has not been mentioned as the quantity present in a cup of tea is negligible.

Theobromine is a dimethylxanthin and caffeine a trimethylxanthine, both are purine derivatives, and their effects so far as the kidneys are concerned are similar.

*Acalypha indica* Linn (Sanskrit—Arittamunjayrie, Hindi—Khokali, Bengali—Muktajuri) is indigenous to India; it has emetic properties and may be used as a substitute for senega in bronchitis, but it will not replace *Psychotria ipecacuanha* Linn as an amœbicidal drug.

(Sd.) J. GUPTA.

DEPARTMENT OF PHARMACOLOGY,  
SCHOOL OF TROPICAL MEDICINE,  
CALCUTTA.

The 5th March, 1942.

## Service Notes

### APPOINTMENTS AND TRANSFERS

THE services of Lieutenant-Colonel H. K. Rowntree, M.C., I.M.S. (Retd.), Additional Deputy Director-General, Indian Medical Service (Stores), are replaced at the disposal of His Excellency the Commander-in-Chief in India, with effect from the 28th November, 1941.

Lieutenant-Colonel A. S. Fry, on transfer from Simla, assumed officiating charge of the office of Professor of Operative Surgery, K. E. Medical College, Lahore, on the forenoon of the 6th February, 1942.

Major B. A. Porritt is appointed Additional Officer at the Medical Stores Depot, Lahore Cantonment, with effect from the forenoon of the 11th December, 1941.

Major B. N. Khan is appointed Deputy Assistant Director-General (Medical Stores), Medical Stores Depot, Madras, with effect from the afternoon of the 22nd December, 1941, *vice* Lieutenant-Colonel W. M. Will appointed to officiate as Additional Deputy Director-General, Indian Medical Service (Stores).

On transfer to Lahore, Major G. J. Joyce made over charge of the office of Civil Surgeon to Dr. Ram Singh Sharma, on the afternoon of the 31st January, 1942.

On transfer from Amritsar, Major G. J. Joyce assumed charge of the office of Civil Surgeon, Lahore, on the afternoon of the 2nd February, 1942, *vice* Major S. Smyth.

On transfer from Lahore, Major S. Smyth assumed charge of the office of Civil Surgeon, Simla East, on the afternoon of the 5th February, 1942, *vice* Lieutenant-Colonel A. S. Fry.

The undermentioned Lieutenants (on probation) are confirmed in their rank, with effect from the dates specified:—

#### LAND FORCES

##### (Emergency Commissions)

J. L. McCallum. Dated 3rd January, 1941.

C. M. Bisset. Dated 13th March, 1941.

W. G. Anderson. Dated 15th March, 1941.

12th April, 1941

A. E. Stevens. J. D. Hardy.

E. L. Lloyd.

F. Lake. Dated 13th April, 1941.

A. D. Iliff. Dated 15th April, 1941.

5th May, 1941

L. J. Michael. R. H. Neeve.

6th May, 1941

H. C. Duncan. H. W. T. Martin.

F. T. Harrington.

G. D. Lehmann. Dated 5th June, 1941.

6th July, 1941

H. Flack.

J. H. Arthur.

The undermentioned Lieutenants (on probation) are confirmed in their rank, with effect from the date specified:—

INDIAN LAND FORCES. INDIAN MEDICAL SERVICE (DENTAL BRANCH)

##### (Emergency Commissions)

5th June, 1941

R. N. Dogra.

W. Singh.

I. M. Manchanda.

R. B. Das Sagreiya.

5th July, 1941

S. F. Ilahi.

V. S. Sehgal.

R. Pratab.

J. R. Das Ahuja.

M. Raj.

M. Shafique.

W. J. Siqueira. Dated 6th July, 1941.

##### (Emergency Commissions)

##### To be Lieutenants

Walter Neville Owen George. Dated 27th September, 1941, with seniority from 27th September, 1940.

Desmond Stopford Muloch Euraght-Mooney. Dated 27th October, 1941, with seniority from 27th October, 1940.

Michael Seager. Dated 27th October, 1941, with seniority from 27th April, 1941.

#### INDIAN LAND FORCES

##### (Emergency Commissions)

##### To be Lieutenants (on probation)

5th November, 1941, with seniority from

5th August, 1941

Sebastian Alex DeSouza.

Charles Andrew Martin.

Lovel Austin Noel Greenway.

Joseph Willoughby Meyers.

Gilbert Nicholas Rodgers.

Godwin Lionel Robbins Tapsall.

Reginald Francis Fleming.

Clive Hope Smith.

Frank Ernest Buckler.

Henry Louis Francis.

George Lewellyn McDermott.

Norman Valetine Mervin Stevenage.

John Bernard Cecil de Lemos.

Denis John Burnett.

George Frederic Martinus.

Wilfrid Eric Joseph Ward.

Ernest Edmunds Vaughan.

6th November, 1941, with seniority from

5th August, 1941

Aurthur Norman deMonte.

Cyril Francis Vieyra.

James Stephens Percival Coutts.

Arthur Benjamin Osborne.

James Ernest Garson.

7th November, 1941, with seniority from

5th August, 1941

Patrick Frank Fanaken.

Robert Mascarenhas.

James Anthony Amor.

8th November, 1941, with seniority from

5th August, 1941

Henry Clarence Halge.

Robert James Foy Camprell.

William Roger Kirkpatrick. Dated 11th November, 1941, with seniority from 5th August, 1941.

John MacNeish Stirling. Dated 17th November, 1941, with seniority from 5th August, 1941.

Champadil Krishnan Padmanava Menon. Dated 2nd February, 1942.

Chitra Kanaka Prasada Rao. Dated 3rd February, 1942.

Raman Viswanathan. Dated 4th February, 1942.

Gnanapragasam Pubala Rayen. Dated 5th February, 1942.

Vellore Ratnam Thayumanaswami. Dated 29th January, 1942.

2nd-Lieutenant F. M. W. Harrison (E. C. O.) is appointed as an Additional Officer at the Medical Stores Depot, Bombay, with effect from the forenoon of the 5th January, 1942.

#### PROMOTIONS

##### *Brevet-Colonel to be Colonel*

B. C. Ashton, V.H.S. Dated 13th October, 1941, with seniority from 1st January, 1935.

Lieutenant-Colonel Jamal-ud-Din has been advanced to the higher position of his rank in the increased pay admissible.

##### *Captains to be Majors*

1st February, 1942

F. R. Cawthorn. F. W. Allinson.  
W. B. Stiver. F. V. Stonham.

##### *(Emergency Commissions)*

##### *Lieutenants to be Captains*

15th January, 1942

|                    |                    |
|--------------------|--------------------|
| K. A. L. Bangash.  | G. J. Bhatt.       |
| S. C. Bose.        | Balbir Singh.      |
| A. Hasan.          | Hari Das.          |
| W. A. Nandedkar.   | N. Krishnaswami.   |
| P. M. Bhandarkar.  | R. L. Pathak.      |
| A. Das.            | L. N. Bakshi.      |
| A. N. Kalra.       | M. R. Thapliyal.   |
| N. S. Gaitonde.    | S. Kesavulu.       |
| A. M. Chakravarty. | M. A. Nair.        |
| H. C. Dhawan.      | K. S. Bhushanam.   |
| S. R. Chowdhury.   | S. Gnaneswaran.    |
| E. Edwards.        | T. V. Ranganathan. |
| K. K. Bhatt.       | P. S. D. Raja.     |
| E. R. Menon.       | P. R. Saksena.     |

S. M. Quershi.

16th January, 1942

A. S. Choudhuri. C. J. David.  
C. L. Bhatia.

1st February, 1942

|                    |                 |
|--------------------|-----------------|
| M. Singh.          | Z. A. Sapru.    |
| T. E. Unny.        | E. B. Mody.     |
| V. R. Sane.        | G. S. Sandhu.   |
| D. J. Shroff.      | K. A. Rashid.   |
| M. S. Kapur.       | M. P. Misra.    |
| P. P. Hazari.      | R. A. Hakim.    |
| A. B. Gune.        | C. M. Muthu.    |
| S. H. Ahmad.       | H. Singh.       |
| N. Rahman.         | D. Singh.       |
| M. D. Joshi.       | D. S. Gupta.    |
| K. D. Veeraghavan. | A. Thimmappaya. |

2nd February, 1942

M. Sumasundaram. N. S. Pillay.  
S. V. Kail. R. Raghavan.

#### INDIAN MEDICAL SERVICE (DENTAL BRANCH)

##### *(Emergency Commissions)*

##### *Lieutenants to be Captains*

1st February, 1942

|                  |                       |
|------------------|-----------------------|
| Muhmud Ahmad.    | Sheikh Nazeer Moham-  |
| Raj Sethi.       | mad.                  |
| Kartar Singh.    | Vere Oswald Arathoon. |
| Munawar Qureshi. | Joginder Singh.       |

interest in many of the applications of dextrose which were hitherto not widely known, and one such is its use as an antiseptic and hæmostatic.

A dextrose poultice or concentrated solution is used to provide biological antiseptics in both internal and external conditions. Offensive discharging wounds or sores, infected operation wounds, pruritis vulvæ and ani, and various skin infections are thus healed.

In the treatment of atonic wounds, gauze bandages soaked in 40 per cent dextrosol solution cause the discharge to cease, and yield better results than the standard therapeutic agents. Where a rapid granulation of ulcers is desired, 2 per cent zinc sulphate solution is added. Sturm incorporates dextrosol into a salve with lanoline for the treatment of ozæna and simple atrophic rhinitis.

A swab soaked in 50 per cent dextrosol solution arrests hæmorrhage, and Eason employs this to arrest bleeding in epistaxis, purpura, and the like, when other local measures fail. In hæmatemesis, oral hourly administration of  $\frac{1}{2}$  oz. of 50 per cent dextrosol solution, besides its styptic action, is of definite nutritional value to the patient.

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## Notes

### DEXTROSOL IN THE NUTRITION AND TREATMENT OF INFANTS

WE have received a copy of a new brochure: *Dextrosol in the Nutrition and Treatment of Infants*.

At this opportunity we would mention that continuity of abundant supplies of dextrosol is naturally enlivening

## Original Articles

## THE PATHOLOGICAL HEART CONDITIONS IN HOOKWORM DISEASE AND THEIR CAUSES

By ROBERT HEILIG, M.D.

*First Physician, Krishnarajendra Hospital, and Professor of Medicine, Medical College, University of Mysore*

THE clinical picture of the heart affection in a severe hookworm infection resembles certain valvular diseases in so many features that one has to describe it in some detail to recognize the characteristic points necessary for the differential diagnosis.

Palpation of the heart region reveals displacement of the apex beat outwards and downwards, usually in the sixth inter-costal space outside the mid-clavicular line, and sometimes situated in the anterior-axillary line; the apex beat is slapping, snapping, quickly disappearing, unless the heart muscle is badly damaged, subsequent to which condition it becomes diffuse, indistinct or palpable. The heart rate is increased to about 110. Sometimes a systolic thrill is palpable in the apical region and occasionally the second pulmonary sound is to be felt in the second left interspace at the left heart border. Epigastric pulsation is frequently present. Percussion shows that the heart is enlarged to the left, and also downwards and to the right, resembling the configuration of an enlarged mitral heart ('third stage'). On auscultation, one finds in the apical area a loud, thumping first sound, corresponding to the slapping apex beat; it becomes fainter with a progressive myocardial weakness. In the same area a systolic murmur is audible, sometimes harsh, sometimes softer, and not rarely conducted towards the axillary region; if it is harsh and low-pitched, a systolic thrill is palpable. The pulmonary second sound is frequently accentuated and a systolic murmur, louder and harsher than that in the apical area, is audible. Both the murmurs are diminuendo in character. Whether a thrill is palpable in the pulmonary area depends again on the number of vibrations produced by the murmur; the lower pitched it is, the more probable is the appearance of a thrill.

X-ray examination reveals a dilatation of the left ventricle, the pulmonary cone and the right auricle; the 'heart waist' or incisure is usually straightened, so that the picture of an enlarged mitral heart results, but the pulsation of the heart silhouette is quite different from that seen in mitral disease; it is considerably increased and resembles the expansile pulsation in aortic regurgitation.

The electrocardiogram of untreated severe hookworm anæmias is very typical. The general 'voltage' is low; the P-Q interval usually normal; the Q R S complex occasionally

more than 0.1 sec. but not severely damaged; the S-T junction sometimes slightly depressed or convex downwards. The main changes are manifested in the T waves. They are almost in all cases very flat or absent (iso-electric) or even inverted, proving beyond doubt a severe diffuse myocardial damage. These changes are reversible to a surprising extent, as shown in the case reports that follow, and they are clearly illustrated in the cardiograms reproduced.

The pulse rate is high in the untreated stage of hookworm anæmia; but a characteristic bradycardia frequently accompanies the improvement of the blood condition. The pulse quality depends on the quality of the heart muscle; it varies from a thread-like to a moderately well-sustained pulse.

The blood pressure is a characteristic feature: a systolic pressure between 95 and 110 mm. Hg. and a very low diastolic pressure of 65 down to 50 mm. Hg. Therefore, a high pulse pressure is so constantly found in untreated cases that a normal diastolic pressure militates against ancylostomiasis as the cause of a severe anæmia or against the diagnosis 'ancylostomiasis heart'. The improvement of the blood condition is accompanied by a moderate rise of the systolic and a definite elevation of the diastolic pressure, reaching about 115/80 mm. Hg.

Neither liver nor spleen enlargement belong to the uncomplicated picture.

The urine does not show any changes due to hookworm disease. Albumin and a pathological sediment are absent; the water elimination and the ability to concentrate are impaired only if œdema or ascites is present.

Though we are concerned here with the heart condition only, the typical behaviour of these patients and their blood condition has to be mentioned because these features are of the greatest diagnostic significance. The greyish paleness of the face and the palate, the dirty earthy tinge of the malar region, the frequently present puffiness of the eye-lids which may be increased up to heavy œdema, are well known. Ascites and general anasarca are common findings, but it is important to emphasize that even the worst degree of this anasarca is not accompanied by dyspnoea without exertion; all these patients lie flat on their back or one side, they do not show signs of air hunger, they are never orthopnoic, and their sleep is not disturbed by dyspnoea. Neither is cyanosis, nor is a sub-icteric tinge present. The blood examination shows the severest degrees of a microcytic, hypochromic anæmia which is compatible with life. Red cell counts of 0.7 millions and a hæmoglobin content of 10 per cent Sahli and less are no rarity.

The differential diagnosis of this condition from a decompensated mitral valvular disease with right heart failure is of the greatest importance as the treatment, as well as the patient's fate, is determined by it. Palpation,



percussion and auscultation of the heart are in many cases not sufficient for the differentiation. The deciding features are dyspnoea up to orthopnoea, usually with a sub-icteric tinge, kidney congestion with oliguria, albuminuria and urobilinuria, a normal diastolic pressure and normal or increased values of red blood cells and hæmoglobin in a heart failure due to mitral regurgitation, and the absence of all those symptoms and signs in ancylostomiasis.

The question as to how hookworm disease causes damage to the heart is answered usually by reference to the anæmia; the murmur is always called a hæmic murmur, the pathological condition of the heart muscle described as flabby due to fatty degeneration, caused by the anæmia. If it is right that the hookworm anæmia *only* is responsible for the accompanying heart condition, all the pathological signs have to disappear with a sufficient improvement of the blood condition, provided they are reversible at all.

*Present investigation.*—To investigate this question, we used the following method. Patients with a severe hookworm anæmia and no other detectable disease have been selected. Before any treatment was started, the orthodiagram, in some cases a teleradiogram of the heart and in all cases the electrocardiograms have been taken, the erythrocyte count and hæmoglobin (with Sahli's hæmometer, 'Amsco', U. S. A. 100 per cent = 15 g.) have been exactly estimated. Then these patients have been put on a uniform anti-anæmic treatment, consisting of freshly prepared Blaud's pills, 90 grains per day. As soon as the hæmoglobin level reached about 30 per cent, an intramuscular injection of calcium gluconate (10 per cent 10 c.cm.) was given daily, while the iron medication was continued until the hæmoglobin estimation showed a value of 40 per cent. At this stage the anthelmintic treatment was performed by giving minims 30 to 45 of carbon tetrachloride combined with minims 10 to 15 of oil of chenopodium, divided in two to three doses. The hookworms passed during the following 12 hours have been counted or—if too numerous—roughly estimated. Four to six motions, examined on alternate days, had to be free from hookworm eggs before a patient was declared as free from hookworms.

The diet consisted of two pints of milk, bread, rice-polishing and one or two eggs, if the patient was willing to take them.

During this treatment, at weekly intervals, the erythrocyte count, the hæmoglobin level and the blood pressure have been exactly estimated, the orthodiagram and, in a few cases, the teleradiogram taken on admission and repeated at a hæmoglobin level of about 25 per cent and again, before deworming, when the hæmoglobin value had reached 40 per cent. The electrocardiogram was recorded once a week simultaneously with the blood examination. In most of these cases and especially when the improve-

ment of the heart condition was not satisfactory before the day of anthelmintic treatment, all these examinations have been repeated eight to twelve days afterwards.

*Results.*—Ninety per cent, i.e., 59 of the 65 cases, followed up in this way, responded with a gradual and very considerable improvement of the heart condition, strictly parallel with the increase of red blood cells and hæmoglobin figures. A few typical cases are reproduced on plate VII under the heading: 'heart improvement accompanying improved blood condition, without deworming' and the essential facts reported in the following case reports:—

Plate VII, fig. 1.—Hindu ryot, 17, investigation, case no. 45—

(a) 26th April, 1941—red cells 1,130,000; hæmoglobin 14 per cent Sahli; blood pressure 90/50; heart measurements (teleradiogram): ml. 10.5, mr. 6; trans. diam. 16.5 cm.; low voltage; T<sub>I</sub>, T<sub>II</sub> flat; T<sub>III</sub> biphasic; signs of a diffuse, moderate myocardial lesion.

(b) 12th May—red cells 2,040,000; hæmoglobin 25 per cent; blood pressure 110/65; heart measurements: ml. 9, mr. 5; trans. diam. 14 cm.; cardiogram: voltage generally increased; T<sub>I</sub>, T<sub>II</sub> almost normal; T<sub>III</sub> flat positive; T<sub>IV</sub> biphasic, flat.

(c) 26th May—red cells 3,320,000; hæmoglobin 42 per cent; blood pressure 115/70; heart measurements: ml. 7.5, mr. 5; trans. diam. 12.5 cm.; cardiogram: perfectly normal in all four leads.

The next day carbon tetrachloride yielded some 500 worms; the motions, examined five times within the next ten days, did not contain any worm eggs.

3rd June—red cells 4,110,000; hæmoglobin 52 per cent.

Thirty days of iron treatment, before deworming was performed, increased the red cells by 2,200,000, hæmoglobin by 28 per cent, i.e., to thrice the initial content, reduced the transverse diameter of the heart by 4 cm. and cured all signs of heart muscle damage, as determined in the electrocardiogram.

Fig. 2.—Hindu ryot, 30, investigation, case no. 54—

(a) 7th October, 1941—red cells 1,250,000; hæmoglobin 10 per cent; blood pressure 95/50; heart measurements (orthodiagram\*): ml. 12.5, mr. 7; trans. diam. 19.5 cm.; cardiogram: T<sub>I</sub> isoelectric; T<sub>II</sub>, T<sub>III</sub>, T<sub>IV</sub> very flat; R<sub>IV</sub> low; diffuse myocardial damage.

(b) 10th November—red cells 3,020,000; hæmoglobin 40 per cent; blood pressure 115/75; heart measurements: ml. 8.7, mr. 5.5; trans. diam. 14.2 cm.; cardiogram: the R waves more than twice the voltage of those in (a); R<sub>IV</sub> increased from 2 mm. to 12 mm.; the T waves in all leads very well developed—an ideally normal cardiogram.

The same day innumerable hookworms were passed after carbon tetrachloride; the motion remained free from hookworm eggs for eight days.

The progress in this case is still more striking than in the previous case. In forty-two days the red cell count increased by 1,800,000, the hæmoglobin content reached more than the fourfold of the initial value, the transverse diameter of the heart was reduced by 5.3 cm., i.e., more than 25 per cent, and the severely damaged myocardium became perfectly healthy as the decided differences in the cardiograms prove.

Fig. 3.—Hindu ryot, 23, investigation, case no. 61—

(a) 23rd December, 1941—red cells 1,240,000; hæmoglobin 12 per cent; blood pressure 100/65; heart measurements (orthodiagram): ml. 12, mr. 9.5; trans. diam. 21.5 cm.; cardiogram: S-T junctions in leads II and III downwards convex; T waves absent (isoelectric) in all leads; these signs prove a severe myocardial lesion.

\* The size of the orthodiagrams, used for reproduction, was reduced photographically to maintain exactly the natural proportions.

PLATE VII  
HEART IMPROVEMENT ACCOMPANYING IMPROVED BLOOD CONDITION WITHOUT DEWORMING.

Lead

I.

II.

III.

IV. (back to apex beat)

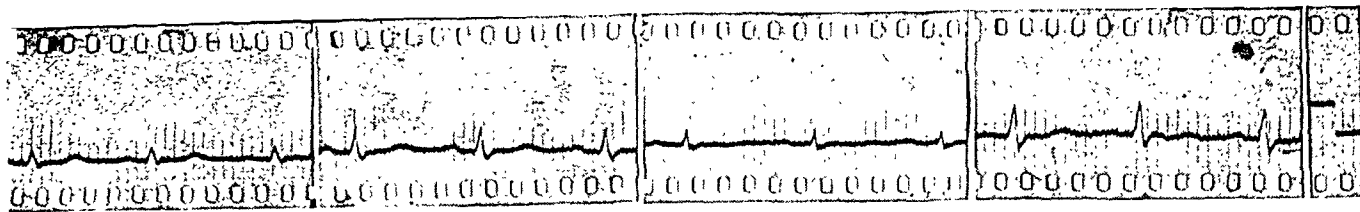


Fig. 1a.

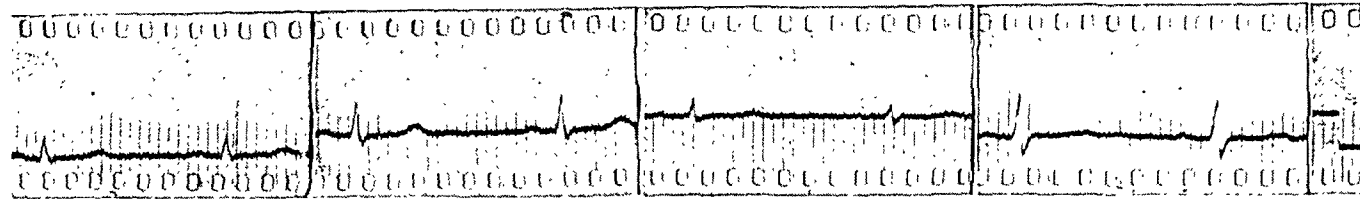


Fig. 1b.

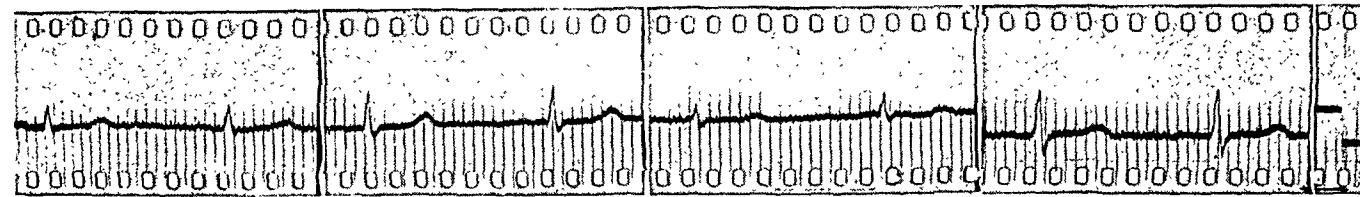


Fig. 1c.



Fig. 2a.

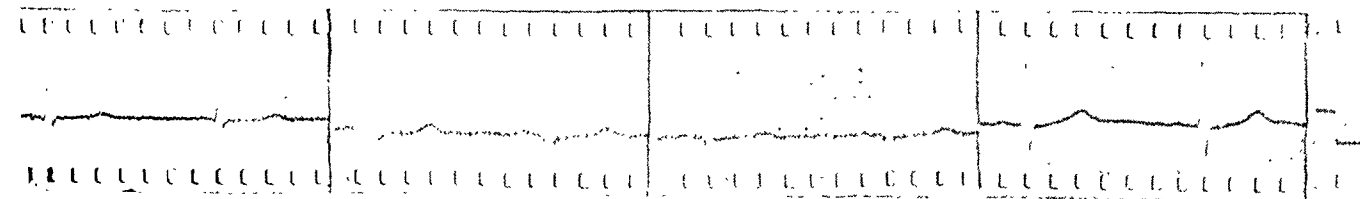


Fig. 2b.

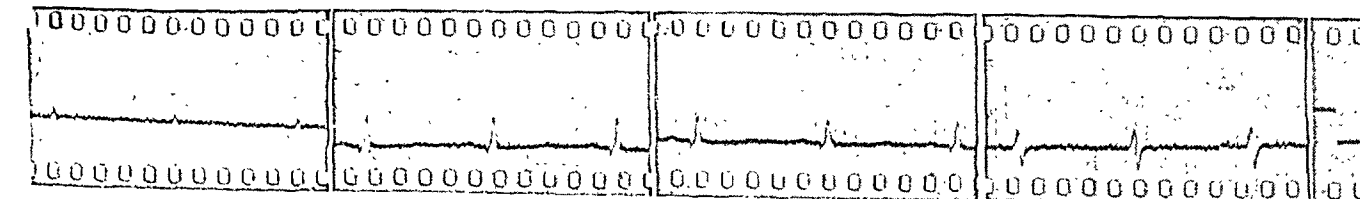


Fig. 3a.

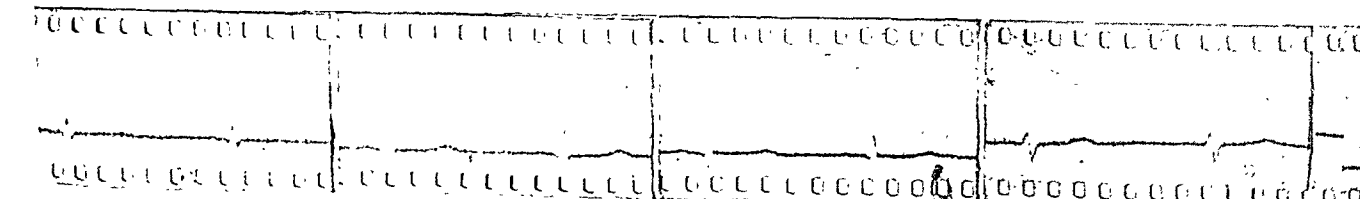
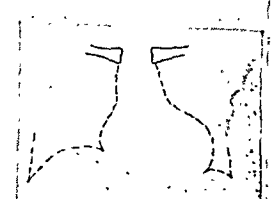
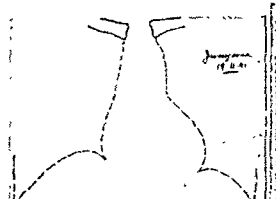
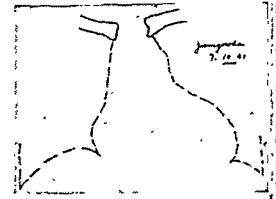


Fig. 3b.



# PLATE VIII

I.

II.

III.

IV. (back to apex bc

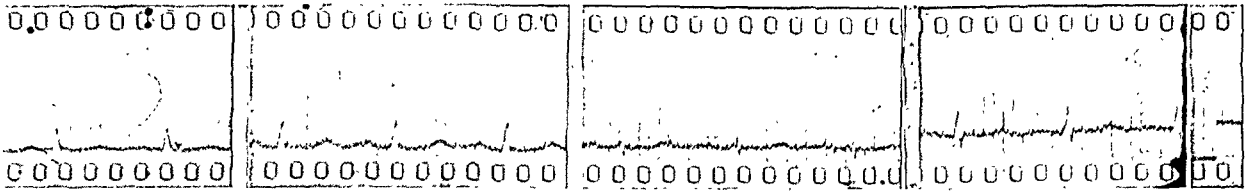


Fig. 4a.

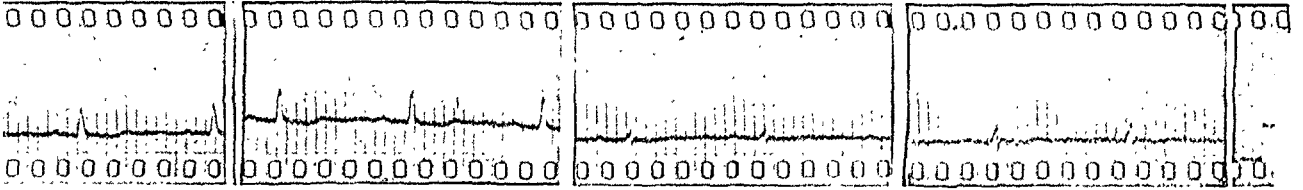


Fig. 4b.

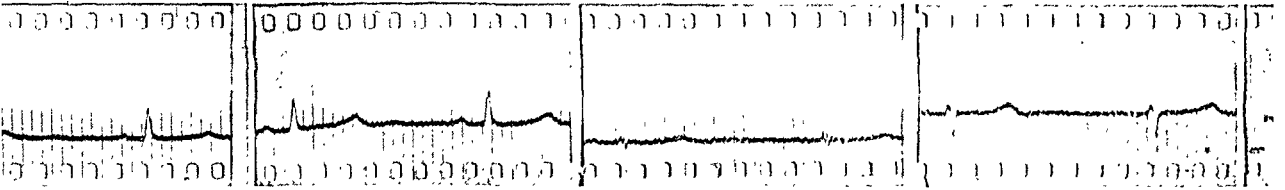


Fig. 4c.

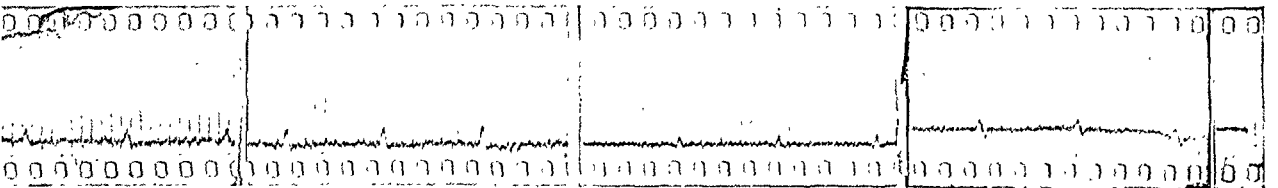


Fig. 5a.

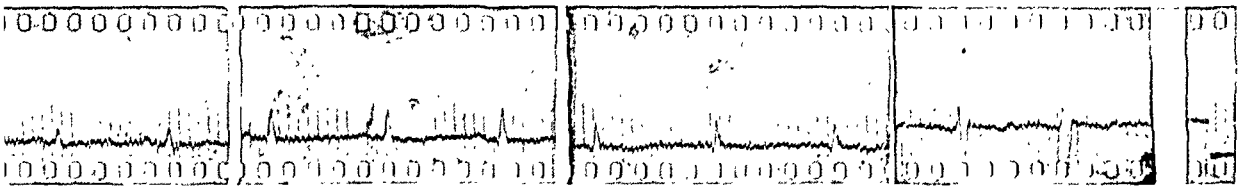


Fig. 5b.

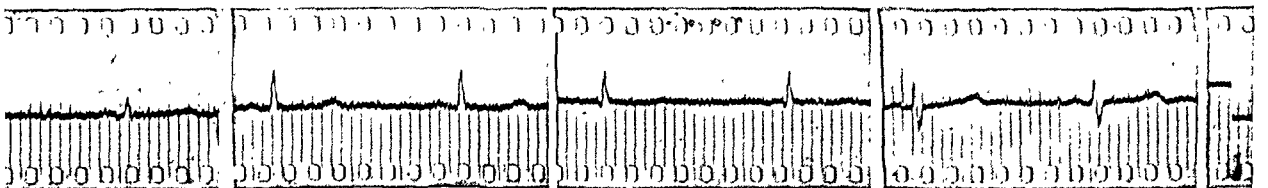


Fig. 5c.

(b) 12th January, 1942—red cells 3,120,000; hæmoglobin 36 per cent; blood pressure 110/70; heart measurements: ml. 10, mr. 5.4; trans. diam. 15.4 cm.; cardiogram: increased voltage in leads II and III; the previously pathological S-T junctions are straight; the previously absent T waves became highly positive in leads II and III, positive in IV; Tr is still hardly visible, but it can never become much higher because of the constitutionally low Rr. The signs of a myocardial damage disappeared.

16th January—hæmoglobin 40 per cent; carbon tetrachloride + oil of chenopodium were administered and hundreds of worms passed.

Hardly three weeks of anti-anæmic treatment increased the red cells count by 2,100,000, trebled the hæmoglobin content, reduced the heart transverse diameter by 6.1 cm. (1) and improved the cardiogram amazingly.

#### Discussion

It may be mentioned that simultaneously with the writing of every cardiogram, the standardization is recorded; it is reproduced at the end of the respective cardiograms on the plate, thus proving that the voltage of the cardiograph (Siemens) was constant and the changes were due to the altered myocardial condition only.

Simultaneously with these rapid changes of the cardiographic, radiological and blood picture, the pathological heart signs on palpation and auscultation disappear. The slapping, rapidly vanishing, displaced apex beat, which is due to the diminished filling of the dilated left ventricle, moves in the normal area and, if distinctly palpable, becomes normal in character; the corresponding first sound loses the abnormal accentuation.

In many cases the systolic murmur in the mitral area disappears entirely when the size of the left ventricle and the pulse rate have been normalized; it owes its existence to two factors, the increased velocity of the blood stream (Porter, 1937), which is a consequence of the severe anæmia, and, most probably, to a relative mitral insufficiency, which necessarily develops with the dilatation of the flabby left ventricle, to which the valvular ring yields easily.

The systolic murmur in the pulmonary area becomes fainter and finally inaudible with complete recovery; it results probably from a functional supravulvar pulmonary stenosis, produced by the compression of the pulmonary artery between the dilated right ventricle and the chest wall; with the reduction of the ventricle to normal size, the compression ceases and the murmur disappears.\* Similarly the palpable closure of the pulmonary valve and the accentuation of the pulmonary second sound are not more perceptible; they have been due to

the fact that the dilated right ventricle approaches the pulmonary artery closer to the thoracic wall so that the closure of the pulmonary valve is better conducted. Another sign that the right ventricle has reached normal size is the disappearance of the epigastric pulsation. The typical convalescence bradycardia and the rise of the blood pressure have been mentioned already.

*Edema.*—The œdema is absorbed in many cases with the improved blood condition, due most probably to the increased protein content of the blood plasma. To eliminate an ascites in hookworm disease we found ammonium chloride grs. xv with calcium chloride grs. x three to five times a day, combined with urea, drachms v three times a day, by far the most effective and harmless diuretic (Heilig, 1941).

Only 90 per cent of our cases responded in this way to anti-anæmic treatment, before deworming was performed. Six cases, women all of them, behaved differently.

*Exceptions.*—The findings on admission as well as the treatment have been identical with those outlined before, but in spite of an equally rapid improvement of the blood condition the heart size did not diminish, the cardiogram showed no improvement; on the contrary it was sometimes worse at a hæmoglobin level of 50 than at 15 per cent, the physical heart signs remained almost uninfluenced in spite of a most satisfactory increase of red cells and hæmoglobin. All the pathological heart signs disappeared soon after anthelmintic treatment was effectively performed; complete deworming was the requisite for an improvement of the heart condition. In two of these cases where the first administration of carbon tetrachloride left about a hundred worms behind, the further deterioration of the cardiogram indicated the necessity to repeat the deworming in spite of a further increase of the hæmoglobin level to 67 and 70 per cent respectively. Figures 4 and 5 (plate VIII) are typical representatives of this small but important group:—

Fig. 4.—Female, 25 years—

(a) 4th December, 1941—red cells 1,570,000 per c.mm.; hæmoglobin 12 per cent. Transverse diameter of heart 15 cm.; electrocardiogram: low voltage; T waves flat.

(b) 8th January, 1942—red cells 3,800,000 per c.mm.; hæmoglobin 52 per cent. Transverse diameter of heart 14.5 cm.; electrocardiogram: S-T junction convex downwards (I and II); T waves almost disappeared.

There was no heart improvement (before deworming) in spite of considerable improvement of the blood condition.

(c) 21st January—ten days after deworming red cells 3,950,000 per c.mm.; hæmoglobin 57 per cent. Transverse diameter 11 cm.; electrocardiogram: voltage increased; T waves almost normal.

Fig. 5.—Female, 45 years—

(a) 4th December, 1941—red cells 1,350,000 per c.mm.; hæmoglobin 10 per cent. Transverse diameter 14.5 cm.; electrocardiogram: voltage low; T waves absent.

(b) 5th January, 1942—red cells 3,560,000 per c.mm.; hæmoglobin 40 per cent. Transverse diameter 14.5 cm.; electrocardiogram: voltage increased in II—

\* Several authors noticed a diastolic murmur in various localizations left of the sternum; the description, given by P. C. Gupta (1941), especially in his case 10, where the second sound was absent in the area of this murmur, makes the following explanation probable: the diastolic murmur is of the same origin as Graham Steell's murmur in mitral stenosis; it is due to a relative pulmonary incompetence, consequent upon a considerable dilatation of the right ventricle and pulmonary cone, which causes a stretching of the pulmonary ring to such an extent that the normal pulmonary valve cusps are not able to shut it during diastole.

IV; but S-T convex downward in II and III; T<sub>1</sub>—T<sub>III</sub> absent; T<sub>IV</sub> biphasic.

(c) 12th January, 1942—after complete deworming on 5th January without further anti-anæmic treatment: red cells 3,800,000 per c.mm.; hæmoglobin 45 per cent. Transverse diameter 11 cm.; electrocardiogram: normal in every respect.

These cases show clearly how the blood condition quickly improved, as in all the other cases, but the heart size and configuration remain unaltered. The measurements of the orthodiagrams (a) and (b) in figures 4 and 5, respectively, are the same and the cardiograms prove a progressing deterioration of the heart muscle, expressed by the pathological shape of the S-T junctions and by increasing flattening or even inversion of the T waves. As none of these patients received any other remedy but iron, especially, of course, no digitalis, and as all the patients under investigation have been constantly afebrile, the change in the T waves points unequivocally towards further myocardial degeneration due to the prolonged hookworm infestation. The whole picture changes quickly after complete deworming; the orthodiagrams (c) in figures 4 and 5 and the cardiograms, reproduced alongside of them, leave no doubt that complete restoration of the physiological heart condition in these cases follows and is due to the destruction of the hookworms and could not be achieved by improvement of the blood condition only. To exclude any other factor responsible for this improvement, the iron medication was stopped when deworming was achieved.

### Discussion

The severe hookworm infestation of a high percentage of the population in India confronts health departments with problems of eminently practical importance—that of prevention and mass treatment. All data necessary for successfully combating this public enemy have been discovered or completed in this country by Chandler (1927, 1929), Sweet (1929), Napier (1937), Napier and Das Gupta (1935a, 1936), Maplestone and Mukerji (1929). The main trend of clinical research swing towards the investigation and elucidation of the factors causing hookworm anæmia and establishing the best method of dealing with it in view of the final aim—the eradication of the worm infestation. The result of this research work is that the only economically reasonable and medically safe method of hookworm treatment is to treat the anæmia (with iron) first, until a hæmoglobin value of 40 per cent is achieved, and to deworm the patient with carbon tetrachloride or better with tetrachlorethylene (Maplestone and Mukerji, 1929) afterwards.

This method was worked out by Napier and Das Gupta (1935) in the tea gardens of Assam (Napier and Das Gupta, 1937; Napier, 1937); it was based on the fundamental fact, discovered by these investigators and by Rhoads, *et al.* (1934), that iron cures hookworm anæmia in spite of a persistent heavy hookworm infestation.

The same kind of treatment was used and the excellent results confirmed in hundreds of such cases by Payne and Payne (1940), and Heilig (1941).

The generally accepted opinion as to the cause of hookworm anæmia was therefore that it develops consequently the constant loss of blood, due to the blood-sucking action of the hookworms, and to the simultaneous loss of iron, thus representing a true secondary, iron-deficiency anæmia. The importance or even the existence of a specific hookworm toxin remains doubtful (Napier, Das Gupta and Majumdar, 1941). The other typical manifestation of hookworm disease, the pathological heart condition, attracted less attention during the last decade; in the literature available to us, only one paper was partly concerned with the investigation of the influence of ancylostomiasis on the heart with modern methods (Porter, 1937); the mere clinical observations on auscultatory phenomena (Gunewardene, 1933, 1935) may be only mentioned here.

Porter examined in eighteen patients, suffering from hookworm anæmia, several factors, such as blood velocity, vital capacity, etc., which contribute to compensate the disadvantageous conditions caused by the anæmia. Among other findings, he noticed in all these cases an increased heart size which in some of them was diminished when the hæmoglobin level rose; in others, it remained unchanged in spite of an increased hæmoglobin content. He concludes from these findings that the anæmia causes an initial compensatory dilatation which leads after some time to an irreversible hypertrophy, a theory contrary to all clinical experience which always shows that, if hypertrophy is present at all, it precedes dilatation. The question whether these heart dilatations, which persist in spite of anti-anæmic treatment, would yield to anthelmintic treatment is not even touched; no deworming was attempted in the course of these investigations.

The author took cardiograms only *before* the anti-anæmic treatment was started and not during or after treatment, apparently because he did not find any pathological changes referable to hookworm anæmia; this is certainly due to the fact that those degrees of anæmia and malnutrition, which we find here almost always on admission, are unknown in the U. S. A. Therefore, Porter's—otherwise interesting—observations do not contribute to the solution of our problem, whether the pathological heart conditions, regularly present in severe hookworm disease, are due to anæmia only or to other factors apart from it.

The reported clinical, radiological and especially electrocardiographic findings of our investigation prove that those degrees of hookworm infestation which lead to a severe anæmia are regularly accompanied by a serious, diffuse, myocardial lesion which causes a general dilatation of the heart. The fact that all objective

signs of this heart muscle weakness respond well to anti-anæmic (iron) treatment without deworming in about 90 per cent of our cases, makes it probable that in the majority of ancylostomiasis cases the myocardial lesion is due to the anoxia which is a necessary consequence of such severe hæmoglobin deficiencies. On the other hand, six of our female cases showed no improvement of their heart condition in spite of an excellent blood response to the anti-anæmic treatment; the signs of cardiac damage subsided only when complete deworming was achieved. The myocardial lesion in this small group was apparently due not to the metabolic changes of anæmic origin, but to the presence of the hookworms. In these cases, at least, the hookworms display two different actions, which have not been distinguished previously. One of them causes the microcytic, hypochromic anæmia; this action can be always over-compensated by the supply of massive doses of iron. The other causes a severe myocardial lesion; the only way to cure it is by the elimination of the causative agent, the hookworm. We tried to determine in one of these cases whether high doses of vitamin B<sub>1</sub> (Berin, Glaxo, 200 mg. in 20 days) would improve the myocardial condition, following the suggestion of McKenzie (1939) and Hoff and Shaby (1939) that certain pathological conditions in ancylostomiasis are due to vitamin-B<sub>1</sub> deficiency; at the end of this course the cardiogram showed a further deterioration; deworming was followed soon by a definite improvement also in this case. It is not possible to decide whether the refractory reaction of the heart muscle towards anti-anæmic treatment is due to a qualitatively or quantitatively different action of the hookworms or to an abnormal sensitiveness of the myocardium in this minority group, compared with the vast majority of cases.

### Conclusion

The observations on 65 cases of uncomplicated, afebrile, severe hookworm disease, reported and discussed above, make it certain that the pathological heart signs, which are typical for this condition, are due to a diffuse myocardial damage, which leads to a considerable dilatation of the left and the right heart; the murmurs are not 'hæmic' murmurs only but also, most probably, consequences of a functional, supravulvar pulmonary stenosis and a relative mitral insufficiency, caused by the dilatation. In 90 per cent of these cases all the signs of myocardial degeneration and dilatation vanished quickly and almost completely in strict parallelism with the improvement of the erythrocyte count and hæmoglobin level, in spite of the untreated and persisting hookworm infestation. Six cases showed no change of the pathological heart condition before deworming, though the hæmoglobin level rose from values of 10 to 15 per cent Sahli on admission, to 40 to 60 per cent before anthelmintic treatment was started; in these cases the heart dilatation and

myocardial lesion improved quickly after complete destruction of the hookworms. These facts seem to prove that two factors are responsible for the heart damage in ancylostomiasis, the anæmia and a toxic agent, dependent on the presence of the hookworm; in the majority of cases it is possible to compensate (temporarily ?) the action of the second factor by curing the anæmia, but a minority remains where this factor is predominant and exerts its myocardial damaging influence irrespective of the blood condition. We cannot decide whether this agent is a toxin or an allergin; the eosinophilia, said to be found frequently in ancylostomiasis, points towards the second possibility. However, complete elimination of the hookworms has to follow the anti-anæmic treatment, preferably succeeded by prolonged iron-medication, to get optimum and lasting results.

### Summary

Sixty-five cases of severe hookworm disease have been investigated during anti-anæmic and anthelmintic treatment.

The red blood cell count, hæmoglobin level, clinical, radiological and electrocardiographic findings have been recorded at weekly intervals.

The factors responsible for the pathological heart condition have been discussed.

My sincere thanks are due to our radiologist, Dr. A. C. Devaraj, and to his assistants Messrs. Mohamed Aga and Venkatarangiah, who have spent many hours in tracing the orthodiagrams in the most exact way, and to my assistant Mr. Visweswar, M.B., B.S., who rendered valuable help in many ways.

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## LUNG ABSCESS

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ABSCESS of the lung is aptly defined by Maxwell (1934) as 'non-tuberculous suppuration with cavitation occurring in the lung tissue'. Nowadays, it is generally agreed that abscess and gangrene of the lung clinically are different stages of the same pathological process which is likely to appear under certain conditions. The stage of the suppurative process will depend upon the virulence of the infection and resistance offered by the patient. Thus, when the infection is highly virulent and the patient is debilitated, he is likely to develop gangrene; while if the infection is mild and the resistance of the patient good, he will probably have the comparatively localized intra-pulmonary suppuration called the abscess of the lung.

The purpose of this paper is to report the findings of the study of 53 consecutive case-records of lung abscess that were admitted in Sir J. J. Hospital, Bombay, during the last six years, from 1936 onwards.

The condition is known from ancient times, but it seems that with increased facilities at our disposal for its diagnosis and careful clinical observation has led us to suppose that it is occurring more commonly these days than before. The increase is not real but only apparent. The diagnosis is helped very much by the radiological examination of the chest which has now come to be a routine in chest cases wherever it is available. Thus, the yearly incidence in the present series was as given in the table below:—

| 1936 | 1937 | 1938 | 1939 | 1940 | 1941<br>(up to Oct.) |
|------|------|------|------|------|----------------------|
| 3    | 6    | 10   | 14   | 7    | 13                   |

One can only say that we are more correctly diagnosing lung abscesses nowadays than before. This series includes all cases of non-tuberculous intra-pulmonary suppuration, and so the abscesses secondary to new growth and bronchiectasis are not excluded from these.

*Ætiology*

**Age.**—Abscess of the lung can occur at any age from infancy to old age. The present series includes patients only above 13 years of age and the incidence was as follows:—

| 10-20 | 20-30 | 30-40 | 40-50 | 50-60 | 60-70 |
|-------|-------|-------|-------|-------|-------|
| 1     | 10    | 17    | 17    | 5     | 3     |

The youngest patient in this series was 14 years of age and the oldest was 66 years. The maximum incidence (64 per cent) was found from 30 to 50 years.

**Sex incidence.**—The abscess of the lung is more common in males than in females. There were 50 males and only 3 females in the present series.

The lung abscess commonly occurs either as a post-operative complication or as a result of inflammation of the lung. Rarely, it may occur secondarily to chest injury, actinomycosis, amebiasis, pneumonokoniosis or new growth. Regarding the pathogenesis of post-operative abscess there are two schools of thought. One thinks that the aspiration of the septic material during operations on the upper respiratory passages plays the chief rôle in the causation of lung abscess, whilst the other thinks the embolic phenomena to be the chief mechanism. The operation chiefly blamed is tonsillectomy. Maxwell (*loc. cit.*) has reported that lung abscesses occur frequently after abdominal operations also. In a recent paper, Shah (1939) found only 4 cases out of 50 as due to aspiration and embolism. Taylor *et al.* (1940) while reporting 7 cases of lung abscess support the contention that post-operative lung abscesses are seen to be much less in this country. Fisher and Finney (1940) found that only 15 per cent of 88 cases of lung abscess could be attributed to post-operative complications, whilst pneumonia, broncho-pneumonia and upper respiratory infections were responsible for 49 per cent of the cases in the above-mentioned series. Shah also found that the incidence of abscesses secondary to pneumonia, broncho-pneumonia and respiratory infections was 42 per cent in his series of 50 cases.

In the present series the incidence was as given below:—

## Cases

|  |                  |
|--|------------------|
| Pneumonia, broncho-pneumonia, bronchitis, influenza.                                 | 20 (37 per cent) |
| Unknown (preceding conditions not known, symptoms of lung abscess presenting first). | 31 (58 per cent) |
| Trauma .. .. .   | 1 (2 per cent)   |
| Embolism (after septic abortion)   | 1 (2 per cent)   |

The findings in this series support the observations of Shah (*loc. cit.*) and Taylor *et al.* (*loc. cit.*). The maximum incidence was found to be of so-called primary lung abscess. In this series there was not a single case wherein previous history of surgical operations was elicited.

**Location of abscess.**—It is a general belief that abscess is more common on the right side than on the left, and that it is commoner in the lower lobe than in the upper lobe. This is well-supported by reports in the literature. In

the present series the distribution was as given below :—

|                     |    |                     |    |
|---------------------|----|---------------------|----|
| Right upper lobe .. | 13 | Left upper lobe ..  | 5  |
| Right middle lobe   | 4  | Left middle lobe .. | 1  |
| Right lower lobe .. | 15 | Left lower lobe ..  | 11 |
|                     | 32 |                     | 17 |

Two patients had gangrene of the lung with multiple opacities, both sides without any cavitation, and two others died before the radiological examination could be done.

**Onset.**—The mode of onset will depend upon the aetiology of the abscess. In embolic abscesses the onset is likely to be sudden. In aspiration cases the symptoms generally appear within 6 to 7 days after the operation on the upper respiratory passage. In post-pneumonic abscess the temperature does not come down to normal by crisis within the usual period and assumes an intermittent character. The onset is generally insidious and the patient has a cough with expectoration and fever. Later on, the patient complains of an unpleasant taste in the mouth and a foul smell of the breath. In some cases there is pain of the pleural type in the chest; this is often of localizing value. There may be hæmoptysis—just finging of the sputum. The sputum when collected in a conical glass assumes the characteristic three layers—upper frothy, the middle turbid, and the lower composed of thick purulent material. The foul smell is often the earliest symptom observed either by the patient himself or the relatives. The fever in acute cases comes with rigor, and is high and intermittent. Later, when the abscess is partially open to the bronchus, it assumes an irregular character. The cough is often paroxysmal and is brought on by change of posture. In the present series, cough with expectoration was present in all cases. Fever as a presenting symptom was found in 37 cases (69 per cent), pain in chest in 20 cases (37 per cent), foul smelling expectoration in 34 cases (64 per cent), and hæmoptysis in 9 cases (17 per cent).

**Physical signs.**—Physical signs are often few and will depend upon the situation of the abscess and on the extent of the surrounding consolidation. If the abscess is superficial, there will be signs of consolidation first, e.g., impaired note on percussion and diminished or bronchial breath sounds with few foreign sounds, and later on, when it is in connection with the bronchus, there may be signs of cavitation if the cavity is empty, superficial and of fairly large size, e.g., impaired note on percussion, cavernous breath sounds, and metallic râles. Generally there is leucocytosis from 12,000 to 20,000 per c.mm. The sputum examination shows streptococci, staphylococci, pneumococci and besides these there may be *B. fusiformis* and Vincent's spirochæte. Elastic tissue is frequently found in the sputum. On radiological examination during the early stages

of suppurative pneumonitis, there will be opacity in the lung fields which may simulate lobar pneumonia. The opacity is not homogeneous but patchy and there may be thickening of the pleura over it. Later still, as the lung tissue breaks down and liquefies, a cavity with fluid level becomes apparent. Sometimes this is shown in lateral radiogram only and so it is necessary in suspected cases to have both the antero-posterior and lateral radiograms. Iodised oil if injected generally does not enter the cavity. It may prove useful in diagnosing the bronchiectatic abscess and the abscess formed distal to bronchial carcinoma.

In the present series physical signs were vague as diminished air entry and few foreign sounds at one base in 29 cases, signs of consolidation were present in 22 cases and signs of cavity were found only in 3 cases; clubbing of the fingers was present in 10 cases. Leucocytic count was done in 34 cases; it was above 15,000 per c.mm. in 10 cases, from 5,000 to 15,000 per c.mm. in 22 cases and less than 5,000 in 2 cases. Sputum examination was done in 47 cases out of 53 and was negative to acid-fast organisms in all with repeated observation by the antiformin method of concentration. In the majority of cases, a stained film showed streptococci, staphylococci and pneumococci. In 2 cases only Vincent's organisms were detected. The Wassermann reaction was positive in 3 cases.

**Diagnosis.**—Diagnosis of lung abscess chiefly rests upon the considerations of all the factors collectively as symptoms, physical signs and the result of radiological investigations. New growth of the bronchus will be difficult to exclude since abscess often co-exists distal to the growth, but investigation with lipiodol and the bronchoscopic examination will help to prove the real nature of the condition. It will often be difficult to distinguish clinically between the abscess at an early stage from the pneumonic consolidation. Inter-lobe empyema will have to be excluded.

**Duration.**—The duration of the illness before admission is held by many to be of great prognostic significance. Thus, Fisher and Finney (*loc. cit.*) mention King and Lord's observations that short durations influence favourably towards spontaneous recovery and they also support this by their figures in 88 cases. In the present series, excluding one case where there was a history of illness for one year before admission which is likely to be incorrect, the duration varied from 3 days to 120 days. It was less than 10 days in 17 cases (6 deaths, 35 per cent) and more than 10 days in 36 cases (15 deaths, 41 per cent). The mean average duration of illness before admission in the present series was 30 days. From this it can be seen that patients whose illness before admission exceeded 10 days had a slightly higher mortality than those whose history of illness was less than 10 days before admission. The stay in hospital

varied from 2 hours to 130 days, the average being 27 days.

**Results.**—The average mortality for lung abscess still ranges from 30 to 40 per cent for cases treated with combined procedures—medical and surgical. In the present series of 53 cases, 23 patients were discharged much improved clinically and radiologically. There were 21 deaths (39 per cent). Nine patients were discharged at request against medical advice.

**Associated conditions.**—Four patients had diabetes mellitus. Two suffered from acute bacillary dysentery while under treatment for abscess lung. Two had chronic diarrhoea, without blood and mucus in the stools. Two patients had empyema along with the abscess. One had severe anæmia and in one there was suspicion of new-growth of the bronchus.

### Treatment

Every case of lung abscess should be given expectant medical treatment from 4 to 6 weeks before any surgical procedure is contemplated, because there is a definite tendency to spontaneous recovery in a certain number of cases and the medical treatment in the form of rest, postural drainage and drug treatment may help this natural tendency.

Complete rest in bed assists in building up the resistance of the patient. He should have plenty of fresh air without exposure to draught and should have good appetizing, nourishing, high-vitamin diet.

**Postural drainage.**—As soon as the diagnosis is confirmed, the location of the abscess should be decided by radiological examination, and, taking into consideration the situation of the abscess, the patient should be encouraged to assume the special posture as required. There is a special bed devised for this purpose by Nelson. If this bed is not available, simple bending over the bed is often useful. An abscess in the upper zone can be drained with the patient sitting well propped up. In an abscess in lower zone, the patient should be asked to bend over the bed, with the palms of the hand supporting him on the ground. Often the suitable position for drainage is found out by the patient himself by experimenting. The drainage should be done gradually, five minutes morning and evening, increasing the time slowly.

**Drug treatment.**—French writers first advocated this therapy consisting of intravenous injection of 5 c.cm. of 33 per cent alcohol daily, and they reported good results. But English physicians have not found this to be very useful and Edwards (1938) thinks that the claims made are not substantiated.

In the present series, this therapy was used in 43 cases, but unfortunately the value of it cannot be assessed as some other form of treatment was also used at the same time.

French writers have also reported good results with daily intravenous injection of sodium benzoate, 20 c.cm. of 20 per cent solution.

On the supposition that Vincent's spirochaetes are often present in the sputum in these cases, arsenic, either in the form of sulpharsenol or neoarsphenamine, is given once a week in small doses parenterally.

Recently, Taylor *et al.* (*loc. cit.*) have found marked improvement by M.&B. 693 in 3 cases out of 7. Fisher and Finney (*loc. cit.*) found sulphanilamide beneficial in one case of lung abscess. Taking into consideration the fact that this group of drugs having proved ineffectual against anaerobic organisms, they think that these will not add much to the therapy of chronic lung abscess at least. In the present series 8 cases were given this group of drugs, either orally in the form of M.&B. 693 or in the form of injections of soluseptasine; out of these 5 patients ultimately died. In 3 cases the patients improved comparatively early, but taking into consideration the natural history of the disease and in absence of a control group, it seems rather over-optimism to attribute these successes to particular drug therapy only.

**Surgical treatment.**—Artificial pneumothorax treatment was used in abscesses in early days and it was found that this procedure as a routine treatment in lung abscess is dangerous, the chief risk being rupture of the abscess into the pleura giving rise to pyo-pneumothorax with ultimate high mortality. Thus, Roberts (1936) mentions 11 cases treated by artificial pneumothorax treatment. Nine cases developed acute pyo-pneumothorax and 5 died. He thinks the risk is too much. Maxwell (*loc. cit.*) suggests that it should be useful in abscess deeply situated and in connection with a bronchus.

Bronchoscopic aspiration is found useful where there is definite history of a foreign body.

The most recognized procedure nowadays is thoracotomy. The operation is done in two stages; at first the pleura is made adherent by packing and then the abscess is drained through this adherent pleura.

With these combined medical and surgical procedures the mortality is becoming less and less recently.

### Summary

1. Analysis of 53 case-records of lung abscess is presented. They were studied chiefly from the clinical aspect of the disease and with a view to finding out the common aetiological factors.

2. The series showed 39 per cent mortality. None of the cases followed surgical operation. In the majority there was no previous history of any respiratory infection. Respiratory infections accounted for 37 per cent of the cases only. The abscess was on the right side in 60 per cent of the cases.

(Concluded on opposite page)

## CONGENITAL CYSTIC BRONCHIECTASIS

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**Nomenclature.**—Cyst-like cavities are sometimes found in the lungs, without the presence of any previous infection to account for them. They are evidently congenital in origin. There is a wide divergence of opinion regarding the nomenclature of this abnormality. Oechsli and Miles (1934) attempt to differentiate between cystic bronchiectasis and congenital cystic disease of the lung by invoking the presence or absence of cartilage in the cyst walls. Koontz (1925) uses the terms 'honey-comb lung', congenital cystic disease of the lung, congenital bronchiectasis and foetal bronchiectasis synonymously, and states that all types exhibit the histology of the bronchus in their epithelial lining, smooth muscle, and cartilage. King and Harris (1937) and Oughterson and Taffel (1936) agree as to the histological picture found in all the cases. Carr (1891) used the term bronchiolectasis to indicate that the pathological changes in his cases were limited to the bronchioles. In the light of recent knowledge they would be considered as typical examples of cystic or honey-comb lung. Sharpe (1940) prefers to adopt a new nomenclature, namely, 'congenital cystic malformation of the lungs', to show that it is a form of congenital abnormality and not an inflammatory reaction. Though Sellors (1938) considers 'congenital cystic disease of the bronchi' as a more accurate designation, he prefers to keep to the term 'congenital cystic disease of the lung' as it has been commonly accepted in English-speaking countries. Norris and Landis (1933), after a critical evaluation of the evidence available, arrive at the conclusion that, pathol-

ogically at least, all types of so-called 'congenital cystic disease of the lung', solitary or multiple, with the possible exception of those that appear as emphysematous subpleural blebs, are in reality examples of 'congenital foetal cystic bronchiectasis'. In view of the fact that it is impossible to make a clinical differentiation between congenital cystic lung and cystic bronchiectasis in the cases reported as such, and because of the presence of bronchial tissue in the walls of the cysts found in the few cases wherein autopsy had been made, one would be justified in adopting the term congenital cystic bronchiectasis.

It is not within the scope of this paper to discuss the acquired varieties of cyst-like cavities, which might either be saccular dilatations of the bronchioles or bullous emphysemata of the lung parenchyma. In this connection, Caffey's (1940) studies in regional pulmonary obstructive emphysema in infants and children, coming on during or after an attack of pneumonia, are of interest. Ring shadows in the bases of the lungs seen after infection, which Andrus (1940) calls 'pulmonectasis' or localized pulmonary over distention, can be classed as acquired cysts of the lung substance.

**Incidence.**—Carruthers (1940) speaks of Bartholinus as having reported the first case in 1687. Laennec (1846), in his classical *Treatise on Diseases of Heart and Lungs*, makes reference to Bonet (1620-1689), Morgagni, van Swieten, and Valsalva (Laennec, *loc. cit.*), who have reported cases with large cysts in the lung. Koontz (*loc. cit.*) was the first to assemble all the available records in the literature, numbering 108 in all. This gave the necessary impetus for the recognition and collection of a series of new cases by others, thereby furnishing another example of a presumably rare disease becoming much more frequent when the primary impetus is supplied, to observe and report it. King and Harris (*loc. cit.*) tabulated 152 additional cases, reported in the last decade. Sellors (*loc. cit.*) with his 32 new cases brings the total to well over 400. The 15 cases reported below are undoubted examples of congenital cystic bronchiectasis, having been selected out of 300 cases of chronic non-tuberculous lung conditions wherein lipiodol bronchography was done as a routine measure.

**Ætiology.**—The mechanism by which cysts form in the lungs congenitally has been a matter of great speculation. The very existence of numerous theories and explanations is in itself a confession of our inability to arrive at the correct solution to the problem. The original conception dates back to 1880, when Grawitz published his account of 8 cases. He divided them into universal and telangiectatic bronchiectasis and regarded the cysts as being dilated bronchi distended by a collection of fluid. Obviously the explanation is wrong, as it is difficult to understand how dilatation could be caused by accumulation of fluid in open tubes. Klebs, seeing marked hypertrophy of endothelial

(Continued from previous page)

3. Medical and surgical treatment is briefly reviewed

**Acknowledgment.**—I am thankful to Colonel J. M. Shah, I.M.S., Superintendent, Sir J. J. Hospital, Bombay, for allowing me to study the case-records and report the findings. I am also thankful to all the honorary medical staff under whom these cases were admitted.

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tissue, considered his cases as examples of cystic lymphangiomata. The occurrence of hyper trophy has led many to consider some of the cases, at least, as tumour formations. Thus Stoerk (1897) designated a case as cystic bronchadenoma and Heuter (1914) regarded his case as congenital alveolar adenoma. Tooth (1897), Bernstein (1905), and Box (1907) considered the cysts in the lung as being formed by postnatal bronchiolar infection and occlusion. The theory of congenital malformation and bronchiolar distortion is put forward by Pollock and Marvin. Sauerbruch (1927) thought that it was due to prenatal constriction of a bronchus, especially of the left lower lobe, by pressure of the adjacent duct of Cuvier. But there is no proof that obstruction to the bronchus is produced in this way, particularly when the duct of Cuvier is found to disappear at an early stage. Besides, according to this theory, one would expect a lobar distribution of the condition rather than scattered lesions even at the periphery which are commonly found in cystic diseases. Heller (1885) put forward the theory of congenital pulmonary atelectasis as being the cause. According to Sandoz (1907) cysts results from syphilitic infection of the lung. This cannot, however, hold good, as in most of the cases there is no evidence of syphilis.

'Pinching of the pulmonary bud', which grows abnormally into a cystic space, is the explanation advanced by Schenck.

Reisner and Tehertkoff (1937) speak of arrested development with failure of pulmonary parenchyma to form, while bronchial ramifications continue to grow into abnormally large spaces.

Oudendal (1923) raised the point as to whether lung tissue could not be deviated by pleural overgrowth or abnormality. The rapid development of the pleuro-pericardial sac might disarrange the most centrally-placed lung substance, pushing the affected areas containing cartilage, glands, etc., even close to the periphery.

According to another theory, supported by Wood (1940), bronchial budding stops prematurely, and disorderly growth occurs consequently. Chandler *et al.* (1940) report a case of developmental cystic lung in an infant in which disorderly arrangement of the bronchi was found post mortem lends support to the theory of aplasia of the terminal lung elements. Sellors is inclined to view the question of cystic disease as one of atavism or reversion to a more primitive type of lung. Certain similarities between reptilian lungs and cystic lungs can be made out. He has found cystic changes occurring in an unduly high proportion of accessory or abnormal lobes, some of which suggest the tendency to evolutionary regression. Sellors' theory is fascinating though not convincing. If it is a question of evolutionary regression the cyst wall should in all cases be

composed of lung tissue only. On the other hand, bronchial tissue is most often found in the walls of so-called lung cysts, as he himself admits when he says 'that the cysts and dilations are essentially bronchial in character'.

Reviewing the available evidence one is inclined to view the question of cyst formation as a developmental disorder in which either the bronchial budding stops short at a certain stage, leaving the buds with blind ends, or the lung tissue, formed as a result of bronchial budding, fails to expand after birth. In both cases bronchial dilatations are sure to occur, in the first case even during foetal life, and in the second, after birth when the lung expands during respiratory excursions. The mechanism of dilatation in the second case will be practically the same as in acquired bronchiectasis, as expounded by the writer (1941).

*Pathology.*—An excellent description of the pathology of cystic disease of the lung is given by Sellors. It will not be out of place to summarize his findings:—

Pleural reaction in uncomplicated cases is rare. The diseased area is generally contracted or shrunken owing to lack of aerated tissue. On section, usually the cysts appear as round spaces supported by dense tissue. When inflammation has occurred pus inside may be found and the walls have a thickened appearance.

The essential histological picture lies in the lining membrane uniformly maintaining the regular character of bronchial epithelium. But there is no disorderly disposition of cartilage, muscle and elastic tissue. There is extreme variability in their location and proportion.

Sellors gives a tabulated histological differentiation between congenital cysts and acquired dilations:—

| Congenital cysts  | Acquired bronchiectasis  |
|---|--|
| 1. Smooth lining, little contents unless infected.  | Rough dirty lining, perhaps ulceration and pus formation.  |
| 2. Regular columnar epithelium unaltered by mild degrees of infection.  | Columnar epithelium shows inflammatory changes with ulceration, metaplasia and formation of granulation tissue.  |
| 3. Predilection for parts of the lung not affected by acquired lesions, i.e., subpleural areas, middle lobes, apices. | More centrally placed with a distribution that tends to be uniform over a lobe or lobes, particularly the lower. |
| 4. Relationship to the line and direction of air tubes not obvious.   | Lie in the line of normal bronchial anatomy.   |

In many cases the distribution of cysts is such that they do not necessarily affect the whole lobe and, in consequence, it is possible to find normal alveolar tissue in close relation to the cysts. In some cases, on the other hand, there is complete absence of alveolar tissue. Even after most careful search, no connection has been established and it can be concluded that cysts and alveolar areas are separate units.

*Classification.*—Lenk's (1933) classification into sac and honey-comb lungs is not adequate to include the different varieties met with. Sellors' classification is as follows :—

- (1) Solitary cysts—
  - (a) Huge balloon or distension cysts in infants, causing great pressure signs.
  - (b) Small cysts of the size of an orange—often silent.
- (2) Multiple cysts of variable size—
  - (a) Medium size of groups of two or three near hilum—usually silent.
  - (b) Small cysts the size of a cherry—
    - (i) Lobar distribution.
    - (ii) Diffuse or scattered.

King and Harris suggest the following classification based on mechanism of bronchial obstruction as applied to this disease :—

- |   |                                       |  |
|---|---------------------------------------|--|
| 1. Congenital lung cysts. Stop-valve obstruction. | Solitary. Bronchial communication.    | 1. Check-valve obstruction (balloon cyst). |
|   |                                       | 2. By-pass valve (non-expansile air cyst). |
|   | Multiple. No bronchial communication. | 3. Free large openings.                    |
|   |                                       | 1. Asymptomatic fluid cysts.               |
|   |                                       | 2. Infection. Abscess, gangrene.           |

The histological classification of Maier and Haight (1940) into epithelialized and non-epithelialized cysts is not very helpful clinically. According to them epithelialization may be primary, as in congenital cysts, or secondary, as in acquired infected cavities into which epithelium grows into the bronchi.

Wood (1940) gives x-ray sorting of cysts into berry cysts, bubble cysts, balloon cysts, and fluid-filled cysts.

*Symptomatology.*—The clinical manifestation varies with the nature of the different lesions. One of the striking features is the frequency of making wrong diagnosis at the outset. Cases 3 and 8 in the series reported below illustrate this point as the diagnosis of cystic disease was not made at first.

*Balloon cysts.*—These usually manifest symptoms, either soon after birth or in the later period of infancy. The patient presents extreme cardiac and respiratory embarrassment owing to the sudden distension of the cyst and consequent mediastinal displacement. Signs of asphyxia with cyanosis are commonly noticed. If relief is not given by aspiration of air the child would die. Crosswell and King (1933) report the case of a child with balloon cyst in which relief from symptoms was obtained only by 'aspirating 8,000 c.cm. to 10,000 c.cm. of air from the cyst'. Subsequent infection of the cyst 'contributed to its obliteration, and consequent recovery of the child'. Case 3 in the present series is illustrative of the above condition though the symptoms were not so urgent as is commonly seen in this type.

*Solitary cysts.*—These are usually symptomless. Only accidental x-ray examination will

reveal the condition unless they get infected, in which case they may even be mistaken for lung abscess. In support of their congenital origin other congenital abnormalities, such as heart disease, cystic kidneys, cystic liver, are found to be co-existent in some cases.

*Multiple cysts.*—These may be of medium size or small and berry-like. They are also discovered by accident only, unless they get infected early, as in case 7 of the series. Case 4, on the other hand, began to exhibit a few symptoms during adolescence. When infection occurs, symptoms will be like that of a case of acquired bronchiectasis. X-ray examination alone will reveal its congenital nature. In a few cases, recurrent hæmoptysis will be the only symptom, as in cases 9 and 10. As in the majority of cases, only a few cysts are seen in the region of the right lung, routine physical examination may not reveal any physical signs. The cysts, as a rule, have wide necks opening into the bronchi. Hence postural drainage is easy. Radiologically multiple ring shadows, often overlapping, are clearly seen. X-ray after lipiodol instillation will clinch the diagnosis.

*Physical signs.*—Signs depend upon the nature, number, size, contents, and situation of the cysts. Expansile balloon cysts will have all the signs of pneumothorax under tension, with tympanitic resonance, loss of breath sounds and mediastinal displacement. Small cysts generally do not produce any physical signs. When infected, however, multiple cysts may give rise to bubbling râles, on the affected side. Large fluid cysts, when situated near the periphery, may simulate pleural effusion with diminished movements, diminished vocal fremitus, dullness on percussion and diminished or absent breath sounds.

*Complications.*—Most of the complications arise out of infection. Chronic infection gives rise to the classical symptoms of bronchiectasis, namely paroxysmal postural cough, fetid expectoration and clubbing of the fingers. Acute infection leads to the production of bronchopneumonia, pneumonitis, abscess, pyo-pneumothorax, etc. Abscess of the brain might also occur as a complication, as in one of the cases in the present series.

Repeated hæmoptysis occurs as a complication, as in one of the cases reported. In some cases, rupture of the cyst may lead to spontaneous pneumothorax.

*Diagnosis.*—In many cases where there are neither symptoms nor physical signs the diagnosis must be made by radiogram. Contrast radiography will clinch the diagnosis in all cases.

A large balloon cyst may be extremely difficult to differentiate from a massive pneumothorax. Singer, discussing the paper on large infected pulmonary cysts by Maier and Haight, says that the cysts can be differentiated by the presence of strands of pulmonary tissue, which can be visualized by lipiodol. Wood (1934) tries to accomplish the differentiation by injecting air



in the pleural cavity. In the case of a cyst, its outline will be pushed away from the parietal pleura.

Thin-walled tuberculous cavities may cause difficulty in diagnosis. But the presence of tubercle bacilli in the sputum and of tuberculous infiltration in the neighbourhood will help in the differentiation.

Pulmonary abscess cavities have thick walls and a certain amount of surrounding pneumonitis. Besides, the interior is not smooth. History of inflammatory trouble can be elicited in all cases.

Great difficulty will necessarily be encountered in distinguishing congenital cystic disease from acquired bronchiectasis. In such cases, generally, distinction can be made only by histological examination. In acquired bronchiectasis there will always be a previous history of a causative factor operating, mostly respiratory infection. The size, situation and appearance of the cavities are also of importance. In acquired bronchiectasis the dilatations will be found along the line of the bronchioles. They are chiefly oval or circular in shape. There will be irregularities in the size and shape of the remaining parts of the affected bronchioles. Such differences can be easily appreciated in a contrast radiogram. In congenital cystic disease, even an ordinary picture will show multiple ring shadows. Another point of distinction lies in finding cavities, even in the periphery of the lung.

**Treatment.**—Symptomless cysts, so long as they remain without producing any ill-health, can be left alone.

Attempts have been made to aspirate or drain large infected cysts, often with disappointing results. In cases of tension cysts, aspiration of air may bring about temporary relief, but no permanent cure can be effected. Enucleation of congenital cysts has nearly always been unsuccessful, according to Sellors.

The most effective treatment consists in removing the affected portion of the lung. Lobectomy or even pneumonectomy can be performed. Successful results have been reported by Gale *et al.* (1937), Arce (1937), and Roberts.

Conservative treatment consists in postural drainage, bronchoscopic lavage and expectorants. Radical treatment is not justified when there are only few symptoms or none at all. But when there is evidence of toxicity, surgical intervention is advisable.

People with symptomless cysts are well advised to guard themselves from respiratory infections.

### Case reports

**Case 1.**—Female, aged 25 years, was admitted for cough off and on of three years' duration. Cough came on with slight fever each time lasting for ten or fifteen days. No history of similar trouble in the family. Had one or two similar attacks during childhood. Fairly well-nourished individual, slightly anæmic, teeth clean. Expectoration not more than

two ounces a day. No tubercle bacilli in the sputum. No impairment of resonance over the lungs, but plenty of bubbling râles throughout the left lung. Ordinary x-ray showed ring shadows with some irregular opacities here and there throughout the left lung. Lipiodol bronchography revealed multiple cavities all over the left lung (plate IX, figures 1 and 2). **Diagnosis**—cystic congenital bronchiectasis.

**Case 2.**—Male, aged 3 years, was admitted on 12th March, 1941, with cough and irregular fever for six months: extremely emaciated; Mantoux test negative—no tubercle bacilli in the stomach wash. X-ray showed falling in of the ribs on the left side, irregular opacities and ring shadows throughout the left lung. **Diagnosis** of congenital cystic bronchiectasis was confirmed by lipiodol bronchography.

**Case 3.**—Female, aged six months (sister of case 2), was admitted on 13th August, 1941, for fever, cough and dyspnoea of six days' duration. Examination of the chest revealed displacement of the heart to the right, impaired resonance and diminished breath sounds. X-ray lying down showed uniform opacity, in the upper and mid zones on the left side. The opacity was limited below by a curved margin. X-ray in the erect posture showed a huge cavity with fluid level in the centre of the opacity. There were also vacuole-like spaces in the remaining part of the opaque area. Tomography showed the presence of multiple cavities with one balloon cyst. X-ray fifteen days after admission showed only the cyst, without any fluid inside. Temperature remained normal. Cough and dyspnoea disappeared. The child at the time of discharge was in perfect health but for the cystic lung.

**Case 4.**—Medical student, aged 23 years, came under observation in 1936 for cough with some expectoration of a month's duration. He had enjoyed perfect health before. Mantoux test was negative. No tubercle bacilli in the sputum. X-ray showed ring shadows in the left lung. Lipiodol bronchography revealed multiple cysts throughout the right lung (figure 3). His symptoms disappeared by simple symptomatic treatment. He is now a doctor in perfect health, none the worse for the malformation in the lung.

**Case 5.**—Male, aged 17 years, was admitted in 1936 with a history of cough from infancy coming on every winter. Mantoux test was negative. No tubercle bacilli in the sputum. X-ray showed multiple ring shadows in the right lung. Lipiodol bronchography confirmed the diagnosis of congenital cystic lung. He was readmitted in 1941 with very high fever and partial loss of consciousness. Signs of broncho-pneumonia were present. A diagnosis of cerebral abscess was made. He died 48 hours after admission.

**Case 6.**—Male, aged 35 years, admitted in July 1937 for cough with foul-smelling expectoration. He has had cough from infancy. There were no tubercle bacilli. Lipiodol x-ray showed cystic dilatations in the left lung (figure 4).

**Case 7.**—Male, aged 11 years, admitted in August 1941 for postural cough and foul-smelling expectoration; had cough from infancy. Mantoux negative. No tubercle bacilli in the sputum. X-ray showed irregular opacities with ring shadows. Lipiodol bronchography showed cystic dilatations throughout the left lung (figures 5 and 6). But for the morning cough and sputum he is in good health.

**Case 8.**—Male, aged one year and three months, was admitted in January 1935 for extreme emaciation, slight cough and infrequent fever. Physical examination revealed marked displacement of the trachea and apex beat to the left, impaired resonance, distant bronchial breathing and scattered râles on the left side. Mantoux negative, no tubercle bacilli in the stomach contents. Ordinary radiograph showed uniform opacity throughout the left side, but with vacuole-like spaces perceivable through the haziness. Lipiodol bronchography revealed the cystic nature of the lung (figures 7 and 8). (This case was reported by Viswanathan and Kesavaswamy in 1936.)

PLATE IX.



Fig. 1. Case 1.



Fig. 2. Case 1.



Fig. 3. Case 4.



Fig. 4. Case 6.

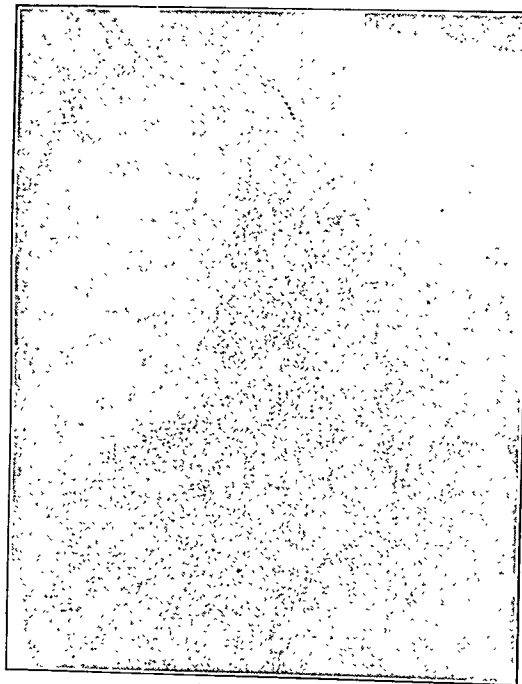


Fig. 5. Case 7.

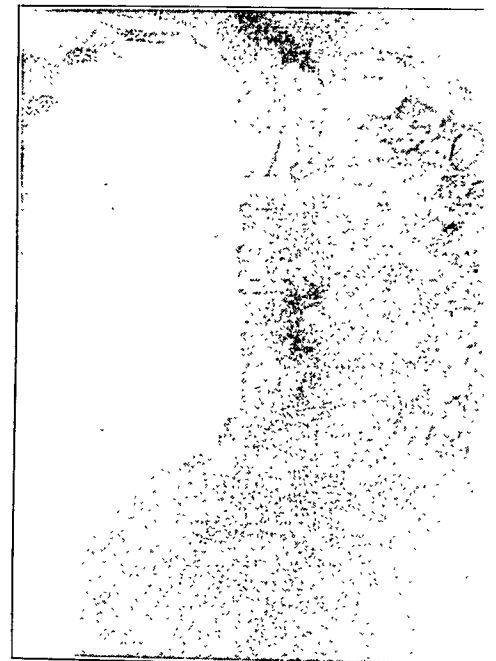


Fig. 6. Case 7.



Fig. 7. Case 8.

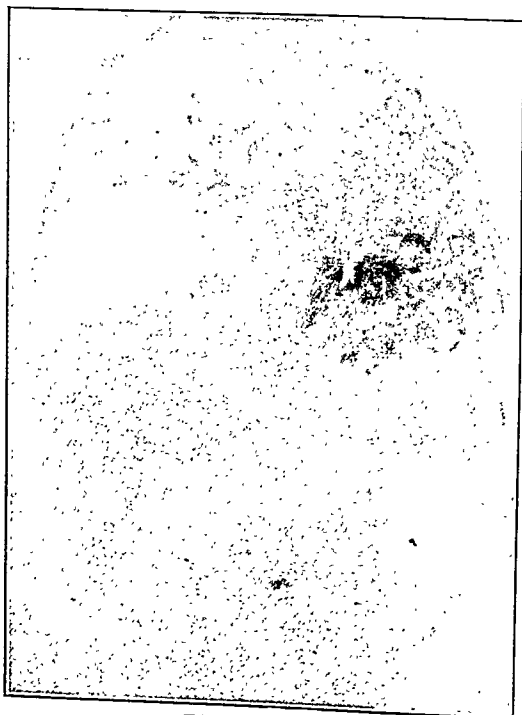


Fig. 8. Case 8.

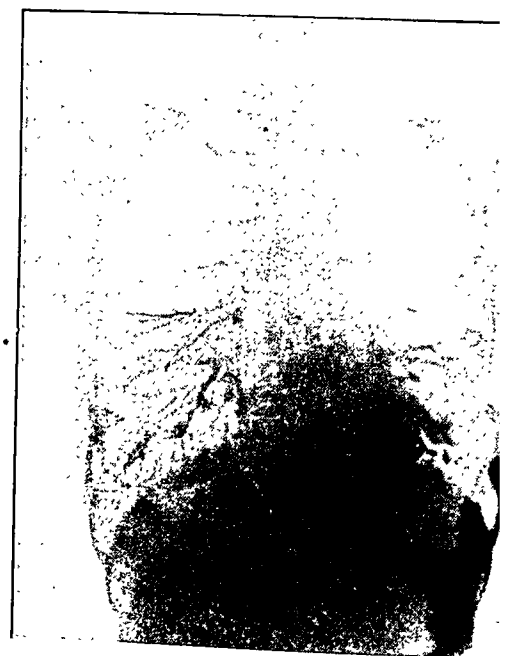


Fig. 9. Case 9.

PLATE X



Fig. 10. Case 11.

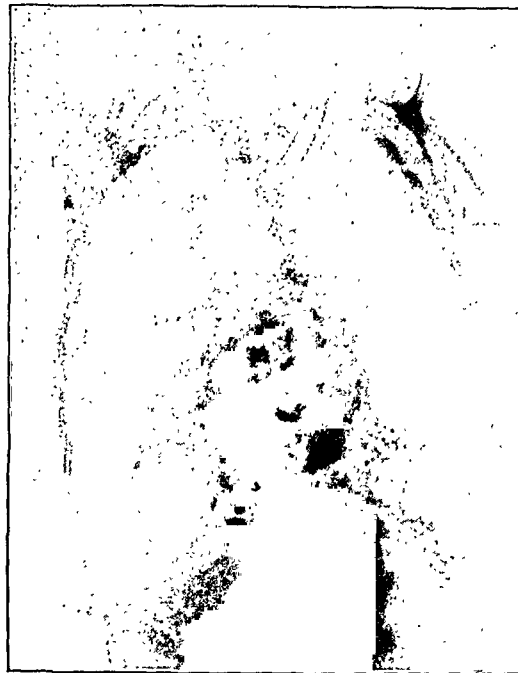


Fig. 11. Case 11.



Fig. 12. Case 12.



Fig. 13. Case 12.

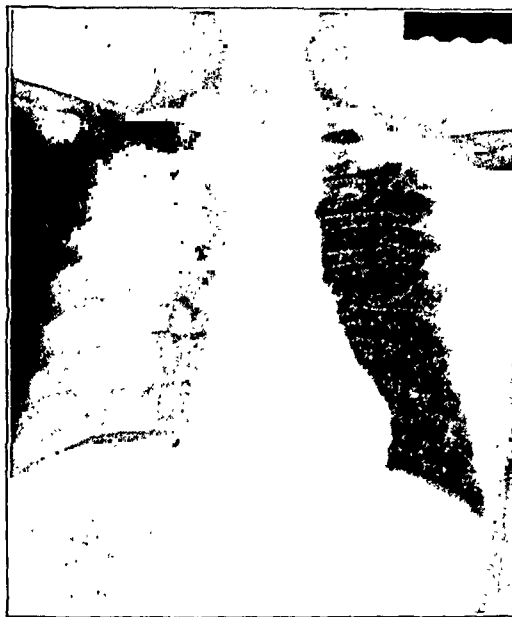


Fig. 14. Case 13.

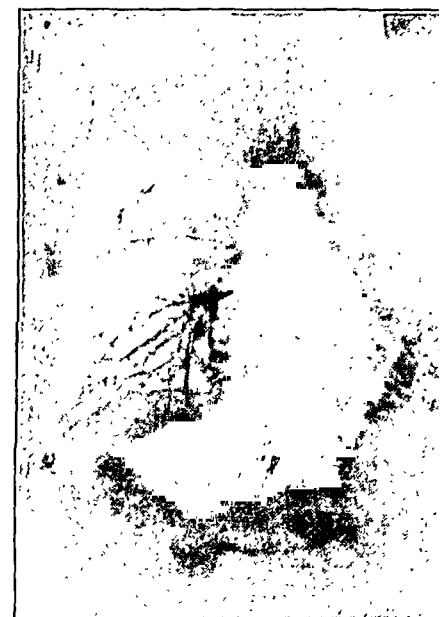


Fig. 15. Case 13.



Fig. 16. Case 14.



Fig. 17. Case 14.



Fig. 18. Case 15.

**Case 9.**—Female, aged 35 years, admitted in 1939 for an attack of severe hæmoptysis. Her first attack was in 1935. Subsequently two more attacks besides the one in 1939. At the time of admission she had bubbling râles over the left side, particularly at the base, evidently due to blood in the bronchioles; these disappeared when the hæmoptysis stopped. X-ray showed a few ring shadows in the lower zone of the left lung. Contrast radiography revealed cavities in the left lobe (figure 9).

**Case 10.**—Female, aged 35 years, had repeated attacks of hæmoptysis since her 20th year. On two occasions the hæmoptysis was so severe that the patient became almost pulseless. In between the attacks she was in perfect health. Contrast radiogram revealed two cysts of the size of a marble near the right hilar region.

**Case 11.**—Female, aged 25 years, came to the tuberculosis clinic on 18th December, 1940, for hæmoptysis and cough of 15 days' duration. She was in perfect health prior to the present attack. Clinically and radiologically she had no signs of tuberculosis. Lipiodol bronchography showed cystic condition of the left lower lobe (plate X, figures 10 and 11, the latter being oblique view).

**Case 12.**—Female, aged 22 years, admitted on 10th October, 1940, for cough from infancy with remissions and exacerbations. No history of acute respiratory trouble at any time. Sputum was negative for tubercle bacilli. X-ray of the lungs after lipiodol injection showed cystic bronchiectasis (figure 12 showing berry cysts and figure 13 oblique view).

**Case 13.**—Male, aged 40 years, came under observation on 10th March, 1941, for hæmoptysis. He spat blood one month back. He had a cough with slight expectoration. History of asthma in childhood. No fever. Pulse rate normal. No tubercle bacilli in the sputum. X-ray showed whorl-like appearance in the left lower zone and above the left hilum. Lipiodol bronchography showed multiple cavities in the left upper lobe (figures 14 and 15).

**Case 14.**—Male, aged 20 years, came to the tuberculosis clinic on 5th November, 1940, for attacks of dyspnoea coming on in paroxysms from childhood. Was having cough with expectoration for the last two years. No tubercle bacilli in the sputum. X-ray showed ring shadows in both lungs. Lipiodol radiogram confirmed the diagnosis of cystic lung (figures 16 and 17).

**Case 15.**—Male, was admitted for recurrent hæmoptysis in 1939. He started spitting blood in 1936. Prior to that he was in perfect health. He used to have cough for a few days after each attack of hæmoptysis. At the time of admission his cough was troublesome though mostly unproductive. Repeated examination of the sputum did not show tubercle bacilli. Lipiodol bronchography showed cystic condition of the left lower lobe (figure 18). Pneumothorax gave him relief from hæmoptysis. But the cystic dilatations were not collapsed. Though his general condition is good now, he is spitting large quantities of sputum showing that the cysts have now become infected.

### Summary

1. An account of the ætiology, pathology, symptomatology, diagnosis and treatment with references to available literature on the subject of congenital cystic bronchiectasis, is given.
2. Fifteen cases of cystic bronchiectasis are reported.

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## PELLAGRA IN BILASPUR STATE

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BILASPUR STATE is situated in Simla Hills, 50 miles from Simla. Its area is 452 square miles and the population is 110,000 (1941 census). It is almost all hilly. The State has an average altitude of 3,000 feet though some of its peaks are over 6,500 feet high.

The State has fine forests in some of its area but most of the area is used for cultivation. Of the lands used for agricultural purposes, most of it is used for cereal crops, such as maize, wheat and rice. Out of pulses, mash is very widely grown.

The source of irrigation is chiefly rain-water. The staple diet of the people is maize and dāl.

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They take wheat and rice as well with occasional use of fish, meat and vegetables.

It cannot be ascertained when this disease first occurred in this State. I have come across many cases of this as well as of other vitamin-deficiency diseases, such as scurvy, rickets, and xerophthalmia, but pellagra is most frequently seen.

The disease is intense in winter months, both sexes suffer but I have come across more male cases. The cases treated have been between the ages of 12 and 38.

I have ascertained that the cause of the disease here is only lack of well-balanced diet because almost all the cases improved with the administration of good food and vitamins in the form of drugs.

An account of 20 cases is given, and I have divided them into two groups:—

1. Typical pellagra cases.
2. Atypical pellagra cases.

They were all cases of pellagra, but distinction was only of severity of disease. Patients with marked skin lesions, gastro-intestinal and nervous symptoms were classified as typical pellagra cases and less definite cases were put in the other group.

### *Typical pellagra cases*

Only four cases were allotted to this group, three of which were treated in the hospital and one as an out-door patient.

*Case 1.*—Hindu female, wife of a carpenter, aged 40 years, duration of complaints 4 years. Patient was pale, and had wide staring look, giddiness, pain in the back, sensation of heat all over the body, nausea, occasional vomiting, sore tongue, diarrhoea, 5 to 6 stools daily, appetite was lessened, weight on admission was 82 pounds.

*Skin.*—This at the back of hands, back of feet, forearms, legs, chest, neck, cheeks was thickened. There were irregular patches on these parts. There was a butterfly patch on the bridge of the nose.

*Nerves.*—Reflexes exaggerated, sleeplessness, irritability and peevishness in paroxysms, otherwise melancholic and silent.

Her staple diet was maize and *dāl*.

*Treatment.*—Maize was cut from her diet and she was put on wheat flour, eggs, vegetables, chicken soup, milk and ghee.

- Drugs.*—1. Nicotinic acid tablets (Glaxo), 1 tablet, three times a day.  
2. 'Vity's' tablets (Bengal Chemical), 1 tablet four times a day.  
3. Marmite, 2 teaspoonfuls, three times a day.

After 20 days of treatment, she began to show improvement. Her temper was improved, appetite increased. For skin she was given salicylic ointment. The skin began to peel off and pale skin appeared. There was no nausea or vomiting, and diarrhoea stopped.

She remained in the hospital for 1½ months when she was discharged as cured. Her weight at the time of discharge was 89 pounds. It is 6 months since she was discharged from the hospital and she is still under observation. She is taking diet as she was told. Her weight has further increased.

*Case 2.*—Hindu boy, aged 12 years, son of a peasant. The father of the patient stated that his elder son had died of the same disease after turning insane.

Staple diet of the boy was maize and *dāl*. The duration of disease was 2 years. The boy was very morose and dull, and took no interest in his work. He was pale and complained of a burning sensation in the palms and soles. He had a sore tongue and diarrhoea, 5 to 6 stools a day. He had no appetite.

*Skin.*—This was dark and thickened on the back of the hands and feet, more marked on the front of the legs.

There were mild tremors of the tongue, reflexes were exaggerated and he had insomnia.

*Treatment.*—Same as in case 1.

The signs of improvement appeared after a fortnight. The number of stools lessened and appetite improved. After 1½ months of treatment, he was cheerful and began to mix with other boys. In 20 days, his weight increased by 1½ pounds.

After 1½ months, he was discharged as cured but he is still under observation.

*Case 3.*—Hindu female, aged 36 years, wife of a Simla riksha coolie. Duration of disease was 8 years. She was extremely anæmic and weak and was unable to walk. She had developed nutritional cataract, and had no menstruation for the last 6 years. She had very severe headache and giddiness.

Tongue was extremely pale and she had no appetite. Diarrhoea, 8 to 10 stools daily, for the last one year.

*Skin.*—There were symmetrical dry thickened desquamated patches, on the back of the hands, feet, legs, cheeks, and around the nose. The genitals were also affected.

*Heart.*—There was hæmic murmur in the pulmonary area of the heart, pulse was feeble and 120 per minute.

The nails were brittle and spoon-shaped.

*Nerves.*—Mild tremors of the tongue, deep reflexes were exaggerated, ankle clonus was present. There were cramps in the body and sleeplessness. The symptoms had aggravated last winter.

*Treatment.*—She was put on the same drug and dietetic treatment as cases 1 and 2 with iron and ammonium citrate (with liquor arsenicalis). In her case, nicotinic acid tablets were given, 6 times a day. She did not show any sign of improvement for about 20 days. She vomited out iron mixture every time it was given, and then it was stopped. Signs of improvement appeared after 2½ weeks. The number of stools decreased and vomiting stopped. Iron mixture was resumed which she accepted. The drug and dietetic treatment was continued for 3 months. In this period, she gained strength and she was able to walk 60 to 80 steps herself. Appetite also improved. Thickened skin also began to peel off. She remained in the hospital for 4½ months and in this period she had gained 16 pounds in weight. She could walk freely and most of her symptoms were completely relieved.

*Case 4.*—Hindu boy, aged 18 years, son of a peasant, duration of disease 1½ years. Staple diet maize and *dāl*. He was melancholic and restless. He could never lie down on the bed for more than ½ hour. He had giddiness, pain in the back and limbs, tongue was sore, and there was copious salivation. There was saltish taste in the mouth. He had vomiting and diarrhoea, 4 to 5 stools a day.

*Skin.*—This was thickened on the back of the arms and legs and there was a typical butterfly patch on the bridge of the nose. He had burning sensation all over the body, specially soles. Deep reflexes were exaggerated. There was a tendency to fall forward when standing. He had a constant idea in his mind that he was being pursued by witches and evil spirits.

*Treatment.*—Same treatment as above was given. He stayed in the hospital for only 6 days. He was brought again after 2 days by his father but he refused to stay. It was 2½ months ago. I have come to know that he is now more melancholic and does not speak to anybody.

(Concluded on opposite page)

## A BRIEF REVIEW OF ONE HUNDRED AND THIRTY-THREE CONSECUTIVE CASES OF QUINSY TREATED BY IMMEDIATE TONSILLECTOMY

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PERITONSILLAR ABSCESS or quinsy is a fairly common variety of 'acute sore-throat' which disables the patient for nearly ten days at a time and may be followed by severe complications and sequelæ. Usually starting with an acute follicular tonsillitis on one side of the throat, the quinsy is fully developed by the fifth day, when there will be severe pain on the affected side of the throat, with painful swelling of the neck, tender cervical glands, offensive breath, coated tongue and teeth, severe dysphagia, excessive salivation dribbling from the mouth and inability to talk clearly. The patient appears toxic with a high temperature, rapid pulse, an anxious expression of the face, the neck slightly bent to the affected side, while

(Continued from previous page)

### Atypical cases

Sixteen more cases were seen and all of them were put in the 'atypical' group. One of them, a male, aged 22, was a cousin of case 2, described above. He was insane for the last 2 years. He was melancholic and did not speak at all. He had a good appetite and no diarrhœa. Skin lesions were very definite on the arm, face, legs, thighs and genitals. He had no treatment at all.

The rest of the cases were aged from 14 to 38. Twelve were males and 3 females. All were Hindus of the poorer classes.

Almost all of them complained of burning sensation of the soles and palms, and 6 of them complained of sore tongue. Three of them improved with the administration of nicotinic acid tablets and well-balanced diet. Some of them are still under treatment.

Seven had skin lesions only, 5 of them improved with a well-balanced diet and marmite administration.

Two had skin lesions as well as severe diarrhœa and they too improved with the above treatment.

In 7, knee jerks were exaggerated. Two of them had also polyneuritis.

### Summary

Twenty cases of pellagra are reported.

Details of four cases are given.

All lived on a staple diet of maize and dāl.

Those that were treated improved on the administration of a well-balanced diet plus nicotinic acid and marmite.

locally, the affected tonsil appears very prominent and congested, with some exudation at the mouths of the crypts; the pillars of the fauces appear congested and œdematous and the œdematous uvula will be pushed to the opposite side. The tenacious mucus collecting about the congested and œdematous oropharynx and laryngo-pharynx can neither be swallowed nor expelled and the slightly impeded and gurgling respiration completes the pathetic picture of agony in a severe case.

It is but fair to the patient that the treatment recommended in such a serious malady must be quite safe, certain in its results, free from complications and ensure against relapses with their possible complications and sequelæ. The best procedure in such a case is surgical interference in addition to such helpful measures as prompt evacuation of the bowels, rest in bed, fluids in plenty, fomentations locally and good nursing. Sulphanilamide therapy is a useful adjunct. The usual surgical treatment recommended in such a case is to drain the quinsy through the soft palate at a site slightly medial to the mid-point between the base of the uvula and the last upper molar tooth on the affected side. In addition, removal of the 'septic tonsils' during the quiescent interval is recommended.

In a previous paper (Rao, 1939) I have discussed the drawbacks of this procedure. Briefly, they are:—

1. Only a large abscess in the upper third of the tonsil fossa can be drained by this incision.
2. An abscess in the middle third or lower third of the tonsil fossa cannot be drained by this incision.
3. This incision drains the abscess at its upper instead of at the dependent pole.
4. It tends to close too soon and frequently needs re-opening.
5. When once the patient is relieved of his acute distress, it is exceptional to find him returning to the doctor for tonsillectomy during the quiescent interval.
6. Thus, the septic focus is left behind and the patients run the risk of similar frequent relapses with their dangerous complications and disabling sequelæ such as arthritis, cardiac complications, neuritis, fibrositis, cervical adenitis, laryngitis, bronchitis and other disabling lesions.

The treatment of this serious and acute condition by immediate tonsillectomy overcomes all the drawbacks pointed out above. By removing the whole tonsil, excellent drainage is provided for the entire peritonsillar space into the oropharynx, and so the abscesses situated in the middle third and the lower third of the tonsil fossa are effectively drained by this procedure. It is needless to add that the necessity for re-drainage does not arise. If the other tonsil, probably septic, is also removed at this occasion, there is no chance of the patient suffering a similar attack on the opposite side. The patient



in his distress is most often quite willing to undergo any operation which gives him immediate and definite relief. Bilateral tonsillectomy on such a patient has the great advantage of not only affording immediate relief but a permanent cure with the certainty of eliminating relapses with their possible complications and sequelæ. The method is quite safe and free from complications, as can be judged by the uniformly satisfactory results obtained in a consecutive, unselected series of one hundred and thirty-three cases of quinsy treated in this clinic by immediate bilateral tonsillectomy during the last three and a half years.

The usual complications that are feared in this procedure are (1) hæmorrhage, (2) septicæmia, (3) pain, and (4) the possibility of performing the operation on a patient in such distress. The observations made in my previous paper regarding the above complications are confirmed by the experiences in the present series of cases.

1. Hæmorrhage, either primary or secondary, occurring from the abscess side is very infrequent. In eight cases of this series, the amount of blood lost varied from half to two ounces and the bleeding occurred on the fourth or fifth day after the operation. In four cases, the blood oozed from the side of the quinsy and in the other four from the healthy side. I have formed the impression that hæmorrhage, either primary or secondary, in these quinsy cases is certainly not more frequent nor more abundant than in the usual operations for 'septic tonsils'.

2. Septicæmia in this series was conspicuous by its absence, in spite of the fact that both tonsils were removed under local anæsthesia after infiltration of 1 per cent planocaine solution (with 10 minims of one in a thousand adrenalin per ounce of planocaine solution) into the pillars of the fauces and the peritonsillar tissues. This is probably explained by the tonsillar fossæ freely draining into the oro-pharynx after the tonsils are removed. In many cases, foul pus escaped under pressure during tonsillectomy on the side of the quinsy, and later, the unaffected tonsil was removed. Even these cases did not develop any septicæmia. The same explanation of drainage of the peritonsillar tissues into the oro-pharynx overcomes the theoretical objection to infiltrating planocaine into the pillars of the fauces on the side in which the abscess was situated.

3. Pain on the side of the abscess is almost negligible immediately after the operation, but is present in variable degree on the healthy side. Slight pain in the ears is frequently complained of, being either reflex in nature or due to tubal catarrh.

4. Most of these 'quinsy' patients on admission can open the mouth widely enough and can be readily operated upon under local anesthesia—usually in the sitting posture. If the general

condition is not satisfactory and the patient unable to open the mouth widely enough, the quinsy may first be incised and drained or aspirated and tonsillectomy postponed for a couple of days. The operation on the side of the quinsy is comparatively easy, since the abscess will have separated the tonsil from part of its bed. In every case in this series, the end-result has been quite satisfactory and there has not been a single fatality.

Some points of interest in this series may be mentioned. Six patients had bilateral quinsy and responded very well to immediate tonsillectomy. The diagnosis of quinsy has been confirmed in over ninety per cent of these cases by aspirating frank pus through the anterior pillar with a wide bore needle and syringe. As mentioned before, only eight cases had secondary hæmorrhage, four from the side upon which the abscess was situated and the other four from the healthy side. None of the cases developed septicæmia. These patients stayed in the hospital, on an average, for only five and a half days after the operation. Many felt fit enough to be discharged on the third day after operation but were detained for two more days to be under observation for any possible secondary hæmorrhage. In this series of one hundred and thirty-three cases, one hundred and two were Hindus, twenty-nine Mohammedans and two were Christians. Seventy-two were men and sixty-one women. The following age-groups are of interest:—

| Age group | Number of patients |    |    |
|-----------|--------------------|----|----|
| 1 to 10   | ..                 | .. | 1  |
| 11 to 20  | ..                 | .. | 47 |
| 21 to 30  | ..                 | .. | 61 |
| 31 to 40  | ..                 | .. | 15 |
| 41 to 50  | ..                 | .. | 5  |
| 51 to 60  | ..                 | .. | 4  |

The number of patients below fifteen years of age was twelve; the number between fifteen and thirty was ninety-seven. The youngest was six years of age and the oldest patient was sixty. Three case histories of particular interest are noted below:—

*Case 1.*—Hindu boy, aged 6 years. Admitted on 9th March, 1941, with a complaint of pain in the throat and dysphagia for three days. Temperature on admission 99.5°F., pulse rate 102 per minute. No previous history of illness. Well-built boy. Local examination revealed quinsy on the left side, confirmed by aspirating frank pus. Patient had slight rhinitis and adenoiditis. He was treated for the cold with 10 per cent argyrol for nasal drops twice daily, sulphanilamide—half a tablet three times a day and the following mixture:—

|                            |    |    |         |
|----------------------------|----|----|---------|
| R Sodii salicylatis        | .. | .. | gr. xx  |
| Sodii bicarbonatis         | .. | .. | ʒi      |
| Spiritus ammonii aromatici | .. | .. | ʒi      |
| Aquam chloroformi          | .. | .. | ad ʒiii |
| F.M. 1/3 t.d.s.            |    |    |         |

*13th March.*—Bilateral tonsillectomy and adenoid curettage were performed under chloroform. During the operation, the amount of blood lost did not exceed

two ounces. The left tonsil was found slightly infiltrated and separated very easily from its bed. The patient made an uneventful recovery and was discharged cured on 17th March.

*Case 2.*—Mrs. G., aged 18 years, housewife, admitted on 4th July, 1940, complaining of severe pain in the throat and dysphagia for eight days. She had suffered from left-sided quinsy a year back and was relieved by a palatal incision and drainage. On examination on 4th July the patient had left-sided quinsy confirmed by aspiration. Temperature 98.4°F., pulse 90 per minute, tongue toxic and coated, teeth dirty and breath very offensive. Local anaesthesia failed in this case and the patient would not even open the mouth satisfactorily. So she was put under chloroform and bilateral tonsillectomy performed within a couple of hours after admission. At 5 p.m. the general condition of the patient was satisfactory. Temperature 100°F. and pulse 110 per minute with fair volume.

*5th July.*—Patient swallows sips of glucose water and other fluids. The subsequent recovery was uneventful. Patient was discharged cured on 10th July.

*Case 3.*—Mrs. Z., Mohammedan, aged 30 years. Admitted on 4th May, 1939, complaining of severe sore-throat and dysphagia of four days' duration. Admits previous history of two or three severe attacks of sore-throat per year for the past fifteen years and definitely says that she was given temporary relief on at least six occasions by palatal incision and drainage during the recurrent attacks of quinsy. On examination, the patient appeared toxic, temperature 100.5°F., pulse 120 per minute, fair volume. Tongue appeared dry and coated, tender cervical glands on the right side.

*Diagnosis.*—Right-sided quinsy confirmed by aspiration. Left tonsil congested and slightly prominent. But the left tonsillar fossa was not aspirated. Prontosil 5 c.cm. injected intramuscularly.

*4th May, 5 p.m.*—Temperature 102.5°F., pulse 120 per minute, patient still toxic.

*6th May, 9 a.m.*—Temperature 98.5°F., pulse 106 per minute. Bilateral tonsillectomy performed under local anaesthesia. Pus escaped into the pharynx from both tonsillar fossae during operation.

*5 p.m.*—Temperature 100°F., pulse rate 132 per minute, fair volume.

*7th May, 9 a.m.*—Temperature 98.4°F., pulse rate 104 per minute. Swallows sips of fluids with fair ease. The further progress of the patient was quite uneventful and she was discharged cured on 11th May.

*Conclusion.*—In view of the very satisfactory results obtained in the present series of one hundred and thirty-three consecutive unselected cases of quinsy treated by me, I feel justified in recommending immediate tonsillectomy as the treatment of choice in quinsy. As pointed out previously, it is quite safe, free from complications, affords immediate relief and permanent cure, and completely eliminates relapses and the unpleasant sequelae attendant on 'septic tonsils'. I am not forcing this line of treatment on the unfortunate patient in agony who may be willing to subject himself to any line of treatment offered, but advise and practise this method, being convinced of its very satisfactory results.

It is a pleasure to express my thankfulness to Dr. J. F. Robinson, Durbar Surgeon and Medical Officer, Krishnarajendra Hospital, Mysore, for the kind encouragement and interest which he has extended to me in my work.

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## A CASE OF AIR EMBOLISM AS A RESULT OF PUNCTURING THE LUNG

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Air embolism is a very rare but a very serious complication of artificial pneumothorax treatment. It occurs most frequently during the induction of pneumothorax, but on certain rare occasions has been met with during a re-fill. Cases have also been recorded in which the entry of a needle into the lung without the introduction of any air caused symptoms resembling those of air embolism, but most of these cases have been ascribed to pleural shock.

There are four possible methods (Alexander, 1937) by which air may enter the blood stream and cause embolism during the induction of pneumothorax treatment:—

- (1) Air may be injected into a pulmonary vein owing to faulty technique. Unknown quantities of room air may enter the circulation directly when an open induction needle is used, without being connected to the manometer.
- (2) Air may be sucked into a pulmonary vein from the tubes and the manometer, there being negative pressure in these venous channels.
- (3) The production of an air pocket under pressure may tear a recent adhesion and open up a venous channel in it, which may absorb the injected air. In such a case embolism may occur some time after the induction.
- (4) If the needle should penetrate an adherent lung, the movement of the lung with respiration across the needle point might cause the needle to open a venous channel to the air of an alveolus or a bronchiole, from which, if it keeps open long enough, it may absorb large quantities of air.

Chand and Wig (1940) published a case in which air embolism occurred as a result of the pneumothorax needle entering the lung tissue though no air had been injected. The occurrence of hæmoptysis at the same time proved that the needle had entered the lung. They thus came to the conclusion that at any rate in that particular case air embolism occurred as a result of puncture of the lung and absorption of air into a pulmonary vein from the ruptured alveoli.

Another case, the details of which are given below, has come to our notice in which air embolism followed the entry of a needle into the lung tissue even though no pneumothorax was attempted:—

G. M. R., male, about 40 years of age, was suffering from pulmonary tuberculosis for the last three years. Sputum was positive. The lesion was of a chronic fibro-caseous type. It was more extensive in the right upper lobe and a few cavities were present there. The left lung showed a few scattered patches of fibrosis. Artificial pneumothorax was tried on the right side but failed, due to the presence of diffuse adhesions. A thoracoplasty was considered undesirable, on account of the presence of a few active signs on the left. It was decided to collapse the cavities in the right upper lobe by an extra-pleural pneumothorax. A successful operation for this was done on him on the 29th May, 1941, by one of us (B. S. N.). The patient stood the operation very well and a fill of about 200 c.cm. of air was given immediately after the operation. Another fill of 150 c.cm. was given 36 hours later. A skiagram taken immediately after the operation showed the extra-pleural cavity created by the operation to be full of air, but a skiagram taken 24 hours after the second fill showed that the cavity had become filled with an opaque mass probably consisting of serum and blood. An attempt was made to aspirate the serum through the intercostal space immediately below the clavicle. A few cubic centimetres of serum were removed but no air could be injected and no more serum or blood could be removed through that space. Next morning it was decided to introduce the needle for aspiration of the serum and blood at a lower level. With the patient lifted on a back rest a needle was pushed in the 4th intercostal space in the axillary line as it was thought that this was the lowest level of the extra-pleural cavity. While the needle was being pushed the patient coughed and looked as if he wanted to expectorate out some sputum but immediately fell back unconscious. The face became deathly pale. The respiration stopped and the pulse became imperceptible. For a moment it looked as if the patient was dead. The back rest was immediately removed—the foot of the bed was lifted and artificial respiration was started. The breathing returned and the pulse became easily perceptible. The heart began to beat strongly. It did so for a few moments and then the pulse became feeble again. The respiration continued normally but the patient became cyanosed. It looked as if the sputum, which he had not been able to expectorate owing to the onset of sudden unconsciousness, was causing obstruction in his respiration. An electric sucker was used to suck out the sputum from his pharynx and a catheter was introduced into the trachea. The patient was moreover put in the prone position and the foot of the bed was kept high. This treatment was continued and in addition injections of 0.5 c.cm. of adrenalin, 1/100th grain of atropine sulphate and 3 c.cm. of coramine were given. The latter injection was given intravenously. The patient gradually revived. Cyanosis began to diminish after about three-quarters of an hour but the pulse became normal only after 5 or 6 hours. When he became fully conscious he complained that the right arm and the right leg were extremely weak.

No detailed examination of his nervous system had been possible while he was unconscious. An examination at this stage, however, showed that the power in the right arm and right leg was extremely feeble. He could use them a little and the paralysis was not complete but there was no doubt about the marked loss of power in the muscles of these extremities. The deep reflexes were exaggerated when compared to the opposite side while the superficial abdominal reflexes were comparatively diminished. The plantar response was, however, flexor on both the sides at this stage. There were no sensory changes, either subjective or objective, and there was no affection of the cranial nerve area.

The paralysis began to diminish steadily after the day of its occurrence but full power in the limbs returned about one month after the operation.

There can be no doubt that the case was one of air embolism involving the cortical area. The original embolism was, however, so short-lived

that it did not leave any permanent area of necrosis. In this case there can only be one cause for air embolism. The other three causes out of the four mentioned in the beginning of the article are out of the question. As the needle was introduced at the lowest limit of the extra-pleural cavity, it seems that it traversed a portion of the lung tissue before it could enter the extra-pleural pneumothorax space. While passing through the lung tissue it ruptured some alveoli and opened a venous channel. The latter absorbed air from the torn alveoli and caused symptoms of air embolism.

Like the case reported by Amir Chand and Wig, this case conclusively proves that at least one important cause of air embolism is absorption of air by a pulmonary vein from the torn lung tissue. To us this seems to be the most important cause of air embolism in artificial pneumothorax treatment. Only two cases of air embolism have occurred so far in the wards of the Rai Bahadur Amar Nath Tuberculosis Institute during the last five years, though during this period some thousands of artificial pneumothorax fills including some hundreds of primary fills have been given. In both these cases the cause was the same—a tear in the lung. Moreover the other causes mentioned as possibilities ought to be rare if proper precautions during artificial pneumothorax fills are taken and one can presume that all experienced workers take these precautions. In spite of the latter fact, however, air embolism has remained an important though a rare complication of pneumothorax treatment.

We may further hazard the view that cases of so-called pleural shock recorded when introducing a needle into the chest for aspiration of pleural effusions, etc., are really cases of air embolism similar in nature to the one described by us in the article. Air embolism due to its very nature can show a multiplicity of symptoms. When the block is in a cerebral or a retinal vessel, the diagnosis is easy and obvious, for localizing symptoms like convulsions, paralysis, and blindness are produced. When the situation of the block is such that such localizing symptoms cannot be produced, and the foundation for a definite diagnosis is thus lacking, pleural shock is often assumed. Durant (1935) described a case of coronary air embolism in which he obtained electrocardiographic evidence of coronary embolism three hours after the accident. The symptoms in this case were bizarre and both hysteria and pleural shock had been diagnosed before the diagnosis was clinched by the electrocardiogram.

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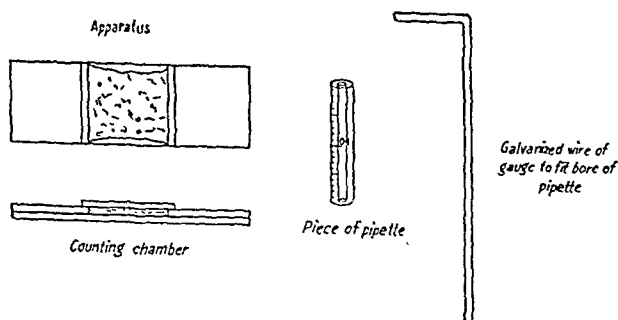
## A SIMPLE METHOD OF COUNTING HOOKWORM EGGS IN FÆCES

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WORKING in a small up-country hospital of 40 beds in a district where light and medium grades of hookworm infestation form a common background to other diseases and hookworm anæmia is not infrequent, the author felt the need of a simple routine method of examining stools for hookworm eggs, which would at the same time give some quantitative indication of the severity of the infestation or of the results of treatment. No special apparatus was available and routine stool examinations had to take their turn with other laboratory procedures. There has been no opportunity for comparing results obtained by the method here described, with standard methods in use in larger laboratories with which it is not desired to compete. This method has been found quick and sufficiently accurate to be clinically useful. It has been in routine use in this hospital for over two years.

A modified glycerine-salt floatation technique is used with apparatus prepared in the laboratory as follows. A thick glass microscope slide 75 mm.  $\times$  25 mm.  $\times$  about 1.7 mm. is cut, by means of an ampoule-file or glass cutter, into three equal pieces. The middle piece is discarded and the two end pieces cemented on to the ends of another slide, so as to leave a space between them 25 mm. square. A suitable waterproof cement is Rawlplug 'Durofix' and the opposing surfaces should first be roughened. Another piece of glass slide about 30 mm. long is laid across the gap and the space thus enclosed has a volume slightly more than 1 c.cm. A straight glass tube pipette of 1 c.cm. capacity graduated in hundredths is carefully cut with an ampoule-file into five short lengths, each containing 0.2 c.cm. Some pieces of stout galvanized-iron wire, of a gauge to fit the bore of the pipette easily, are cut, about 4 inches long. One end should be turned down as a handle and the other filed off squarely (*see diagram*).



Taking a clean dry piece of pipette the specimen of stool is 'stabbed' in a number of places until the column of fæces rises inside to the half-way or 0.1 c.cm. mark. The pipette is pressed squarely down and twisted to ensure

that on withdrawal the column of fæces does not recede. Excess is struck off by a piece of stick passed across the end of the tube the outside of which is also quickly cleaned. Using a piece of galvanized wire as a plunger the column of fæces is expelled on to the middle of the prepared slide. Fluid stools may be drawn up to the mark and expelled by fixing a rubber teat on to the piece of pipette. A saturated solution of sodium chloride in glycerine (*i.e.*, glycerine from a bottle in which solid salt stands at the bottom) is added slowly from a teated pipette, marked to deliver 0.9 c.cm. and thoroughly mixed with the fæces by means of the wire plunger, which is washed with the last drop or two of glycerine. The mixture is covered with the piece of slide and does not quite fill the space. The glycerine is sufficiently viscous not to flow out, if carefully handled. The preparation is then set aside for 30 minutes to allow the eggs to float to the surface, and should be examined within 2 hours after which eggs tend to become crenated or translucent. With a low power 2/3 inch objective focused on the air bubbles all the hookworm eggs are easily seen on the same focal plane, just below the covering slide. It is found that a 1 in 10 emulsion of fæces of this depth (1.7 mm.) is sufficiently translucent for eggs to be seen over underlying particles of debris, though if these are dense the light may have to be increased slightly by opening the iris diaphragm of the condenser. Very large particles do not usually enter the pipette used for measuring, and if they do the specimen should be discarded and the process repeated. All eggs in the area, which is slightly less than a square inch, are counted, and the count multiplied by 10 gives the number of eggs per cubic centimetre of stool. Systematic counting is facilitated by a card disc with a square hole cut in the centre dropped on to the diaphragm inside the eyepiece, thus making a square field. The whole procedure takes only a few minutes, little longer than an ordinary qualitative examination of stool, but as a measured quantity is taken results are comparable. Moreover searching of the whole area ensures an adequate examination, and the volume of stool examined is that of 8 or 10 ordinary coverslip preparations of the same size. Roundworm, tapeworm\*, whipworm and threadworm eggs are also easily seen by this method, if present, and strongyle eggs in dung from the hospital cows have also been found by this means.

Some points in the above technique need further comment. *Flotation fluid.* (a) *Specific gravity.*—Sodium chloride dissolves in glycerine (impurities about 1.5 per cent) to the extent of 9.78 per cent giving a solution of specific gravity

[\* It is not clear which species of tapeworm eggs are referred to, but saturated salt solution in water by flotation or D.C.F. will not bring up *tænia* eggs; eggs of *Hymenolepis* spp. are floated in this solution.—  
EDITOR, I. M. G.]

very nearly 1.300 (1.2964) [Herz and Knoch, 1905, (Seidell, 1920)]. This is higher than either pure glycerine (1.2592), or a saturated aqueous salt solution (1.1960), or a saturated solution of salt in a mixture of any proportions of glycerine and water. Barber (Stitt *et al.*, 1938) used a mixture of equal parts of glycerine and saturated salt solution which according to Herz and Knoch's tables gives a specific gravity of about 1.230. Lane [1925 (Lane, 1940)] has shown that for *Ascaris* and *Trichuris* eggs D.C.F. with a solution of specific gravity 1.200 gave about half the number of eggs as with one of 1.300. The ease with which these heavier eggs are floated by the 1.300 solution used by the writer would indicate a still greater ability to float hookworm eggs, and no trouble was experienced by debris also being floated.

(b) *Viscosity*.—Lane (*ibid.*) showed that with a specific gravity of 1.200 a sugar solution raised hookworm eggs more slowly than did one of common salt. Saturated salt in glycerine is rather viscous so comparative tests were done with aqueous solutions of magnesium sulphate and zinc sulphate adjusted to the same specific gravity of 1.300, the viscosity of the three solutions lessening in that order. Comparable results were obtained with all three. The differences were not significant, but the glycerine salt solution seemed to float eggs slightly better than the others.

*The faecal emulsion*.—Loss of eggs in preparing the specimen cannot occur as the measured volume of stool is transferred directly to the counting chamber. The only possibility of eggs being missed is if they are prevented from floating to the surface by particles of debris. This can be lessened by thorough mixing on the slide and allowing time for the eggs to float up. While admitting that in concentrated emulsions more eggs are likely to be held down by faecal debris than in weaker ones it must be remembered that in this technique eggs only have to rise through the fluid in a given time a maximum distance of 1.7 mm. The area of nearly one square inch should be sufficient for rising and falling streams of particles to avoid each other. The use of wire gauze strainers with their uncertain effects in holding up hookworm eggs is avoided by the narrowness of the bore of the pipette used for measuring which prevents coarse matter from entering.

*Time of floatation*.—The highest counts were obtained after about 1 hour, though from 30 minutes to two hours they were but little lower.

*Accuracy*.—In use we find the method sensitive in detecting hookworm eggs though, as it has been the only method employed, no comparative figures can be given. Its sensitivity is confirmed by the fact that only 4 negatives were encountered in a series of 116 routine examinations of the stools of 'healthy' school children (3.4 per cent). The degree of accuracy that may be

expected is shown by the following table giving the results of three separate counts on each stool specimen:—

| Count 1 | Count 2 | Count 3 | Average |
|---------|---------|---------|---------|
| 3,480   | 3,330   | 3,450   | 3,420   |
| 3,510   | 2,570   | 3,090   | 3,060   |
| 2,870   | 2,200   | 2,480   | 2,520   |
| 2,700   | 1,720   | 2,200   | 2,210   |
| 1,120   | 1,350   | 1,200   | 1,220   |
| 1,200   | 1,320   | 1,120   | 1,210   |
| 880     | 1,530   | 1,060   | 1,160   |
| 1,110   | 1,320   | 1,000   | 1,140   |
| 1,000   | 720     | 890     | 870     |
| 520     | 470     | 580     | 570     |
| 420     | 480     | 510     | 470     |
| 240     | 520     | 440     | 400     |
| 300     | 270     | 370     | 310     |
| 180     | 60      | 140     | 130     |
| 130     | 110     | 60      | 100     |
| 70      | 30      | 20      | 40      |

Reference to this table will show that, although there are discrepancies here and there, no one count differs so markedly from the average as to give a totally misleading clinical picture. Using this method of counting as a basis, results may be grouped as follows:—

Group 1. Light infestations: Count in the tens (10—90 eggs per c.c.m.).

Group 2. Moderate infestations: Count in the hundreds (100—990 eggs per c.c.m.).

Group 3. Heavy infestations: Count in the thousands (1,000—9,990 eggs per c.c.m.).

Group 4. Very heavy infestations: Count in (10,000 and over eggs per c.c.m.).

The highest count we have recorded since using this method is 10,500, but very heavy infestations are not common in our district. It is as easy to return the actual count obtained as to record the group number in which it falls, but when considering the result the margin of error should be remembered.

A high degree of accuracy is not necessary for clinical purposes and cannot be achieved by any method. Several sources of variation are possible, some of which affect all counting methods equally. For instance, we have no guarantee that gravid female hookworms lay eggs at a uniform rate to enable an individual to pass them out in his stool in the same concentration each day. Diet, the taking of purgatives and the physical state of the stool whether solid or liquid, all these may affect the count whichever method is employed. Sampling errors due to uneven dispersion of eggs in the stool are lessened in a method such as Stoll's (Stitt *et al.*, 1938) where 5 grammes of faeces are taken, but this advantage is offset by the fact that only 1/500th part of this quantity (0.01 gramme) is actually counted for eggs, and the multiplying factor being 100, counts below this figure are not shown. In Clayton Lane's (Stitt *et al.*, 1938) D.C.F. method pushed to finality all the eggs from 1 c.c.m. of stool are counted, but this is too laborious for routine clinical use. Apart

from everything else the mere counting of eggs in specimens where the count may run into thousands is no mean feat. Even if only the first coverslip is examined some 750 or 800 eggs must be counted in a specimen containing say 1,000 eggs per c.cm. In the method now described 0.1 c.cm. of stool is taken in a way which tends to lessen sampling errors, and in such a specimen only 100 eggs would have to be counted. Stoll's method would show ten eggs only, but this is more suitable for very large counts extending, for instance, up to 54,000 in Napier *et al.* (1941) series of cases. The writer has unfortunately had no opportunity of comparing his technique with D.C.F., which has been shown to produce most eggs from a given stool specimen. But even if the maximum number of eggs is not obtained, provided the method is reasonably sensitive in detecting and reliable in grading hookworm infestations, it will be of value to clinicians in small hospitals, private practitioners and those without access to elaborate laboratory facilities, as it can be carried out by anyone possessing a microscope.

It may be argued in view of the above difficulties and sources of error, coupled with the fact that the egg count of the stool cannot always be correlated with the patient's clinical condition, that routine egg counts are unnecessary and a waste of time. This argument carries more weight when the counting method employed is separate from the qualitative examination. But the present method combines both and is quick. A return of the number of eggs per c.cm. is of more value to the physician in charge of the case than a mere return of their presence, when no indication is given whether they number in tens, hundreds, or thousands. Routine stool examinations of all patients admitted to our hospital show that a high percentage are infested, though in varying degrees. Patients may be suffering from several different diseases, and the count helps the physician to assess the importance of hookworm in the whole clinical picture. Small counts may safely be ignored or treatment deferred until more urgent conditions have been treated.

Similarly, when considering counts from routine examinations of school children, low counts need not be treated in the absence of anæmia or other indication. For instance, in the group of 116 school children referred to above, 41 (35.4 per cent) were lightly, 68 (58.6 per cent) were moderately, and 3 (2.6 per cent) were heavily infested. All moderate and heavy infestations were treated, but light infections were only treated if there was anæmia, as shown by a hæmoglobin of less than 80 per cent (Sahli : standard 14 grammes Hb. = 100 per cent). It should be mentioned that, as the children come daily from scattered villages, no attempt at hookworm 'sterilization' of the community was feasible. The average egg count for the whole school worked out at 245 eggs per c.cm. It will be interesting to see, when the routine examination is repeated next year, whether as a result of treatment this figure is lower.

The method also provides a useful check of the efficacy of any method of treatment, as carried out in a particular institution. While it is admitted that, for research purposes and the large scale testing of any new drug, egg counts must be supplemented by worm counts from recovered stools, this latter process is tedious and objectionable, and impracticable for most workers. It is submitted that useful clinical material could be obtained from field workers using this method of egg counting, which would otherwise be wasted. For this reason, a table is given below of unselected cases in which repeat counts have been done after treatment. Unfortunately these are only a small minority of cases treated, as most patients do not stay long enough. In many cases in this series, treatment has not been successful in eliminating all eggs, though in nearly all cases the count has been greatly reduced. When treatment succeeds in reducing a patient's count from say 3,000 to 300 and he feels so much better that he goes home, though from a scientific point of view we cannot say he is cured, it is not fair to the method of treatment to exclude such a case from a series. A system of marks is therefore suggested as follows :—

|  |   |   |   |                      |               |
|--|---|---|---|----------------------|---------------|
| Group 4 cases : Reduction of count in same group |   |   |   |                      | 1 mark        |
|  | " | " | " | to group 3           | 2 marks       |
|  | " | " | " | " 2                  | 3 "           |
|  | " | " | " | " 1 (or 0)           | 4 " (maximum) |
| Group 3 cases :                                  |   |   |   |                      |               |
|  | " | " | " | in same group        | 1 mark        |
|  | " | " | " | to group 2           | 2 marks       |
|  | " | " | " | " 1 (or 0)           | 3 " "         |
| Group 2 cases :                                  |   |   |   |                      |               |
|  | " | " | " | in same group        | 1 mark        |
|  | " | " | " | to group 1 (or 0)    | 2 marks "     |
| Group 1 cases :                                  |   |   |   |                      |               |
|  | " | " | " | in same group (or 0) | 1 mark "      |



Marks obtained can be expressed as a percentage of marks possible and this figure would be an approximate index of efficiency for the treatment.

The treatment used was in nearly all cases 2 c.cm. of carbon tetrachloride with 1 c.cm. oil of chenopodium made up with magnesium sulphate 15 grammes and water to 30 c.cm.,

TABLE

| Case number         | Age | Sex | Initial count     | First treatment marks | Count after treatment 1                            | Second treatment marks | Count after treatment 2 | Third treatment marks | Count after treatment 3 | Fourth treatment marks | Count after treatment 4 |
|---------------------|-----|-----|-------------------|-----------------------|--|------------------------|-------------------------|-----------------------|-------------------------|------------------------|-------------------------|
| 1                   | 8   | M.  | Group 4<br>10,500 | 3/4                   | 280  | 2/2                    | 90                      | ..                    | ..                      | ..                     | ..                      |
| 2                   | 50  | M.  | Group 3<br>4,300  | 2/3                   | 240  | 2/2                    | 30                      | ..                    | ..                      | ..                     | ..                      |
| 3                   | 16  | M.  | 3,800             | 1/3                   | 1,100  | 2/3                    | 210                     | 1/2                   | 130                     | ..                     | ..                      |
| 4                   | 50  | M.  | 3,500             | 2/3                   | 210  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 5                   | 5   | M.  | 2,520             | 2/3                   | 490  | 1/2                    | 200                     | 2/2                   | 0                       | ..                     | ..                      |
| 6                   | 25  | F.  | 2,450             | 2/3                   | 280  | 0/2                    | 290                     | 1/2                   | 140                     | ..                     | ..                      |
| 7                   | 12  | M.  | 2,210             | 3/3                   | 0  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 8                   | 9   | M.  | 1,960             | 2/3                   | 900  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 9                   | 9   | M.  | 1,810             | 3/3                   | 10   | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 10                  | 14  | M.  | 1,800             | 2/3                   | 490  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 11                  | 14  | F.  | 1,440             | 3/3                   | 90   | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 12                  | 30  | F.  | 1,020             | 2/3                   | 320  | 2/2                    | 20                      | ..                    | ..                      | ..                     | ..                      |
| 13                  | 50  | F.  | Group 2<br>930    | 2/2                   | 0  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 14                  | 17  | M.  | 920               | 1/2                   | 130  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 15                  | 40  | F.  | 910               | 1/2                   | 800  | 1/2                    | 120                     | 2/2                   | 50                      | ..                     | ..                      |
| 16                  | 30  | M.  | 890               | 2/2                   | 60   | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 17                  | 16  | M.  | 890               | 0/2                   | 980  | 1/2                    | 310                     | 1/2                   | 190                     | 1/2                    | 130                     |
| 18                  | 12  | M.  | 850               | 2/2                   | 30   | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 19                  | 9   | M.  | 810               | 1/2                   | 310  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 20                  | 18  | F.  | 810               | 2/2                   | 90   | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 21                  | 11  | F.  | 810               | 2/2                   | 0  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 22                  | 28  | F.  | 780               | 2/2                   | 0  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 23                  | 37  | M.  | 730               | 1/2                   | 290  | 2/2                    | 0                       | ..                    | ..                      | ..                     | ..                      |
| 24                  | 11  | F.  | 730               | 1/2                   | 180  | 2/2                    | 0                       | ..                    | ..                      | ..                     | ..                      |
| 25                  | 14  | F.  | 640               | 1/2                   | 110  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 26                  | 14  | M.  | 580               | 1/2                   | 330  | 1/2                    | 120                     | 2/2                   | 70                      | 1/1                    | 30                      |
| 27                  | 30  | F.  | 530               | 1/2                   | 280  | 2/2                    | 20                      | ..                    | ..                      | ..                     | ..                      |
| 28                  | 30  | F.  | 450               | 1/2                   | 210  | 2/2                    | 0                       | ..                    | ..                      | ..                     | ..                      |
| 29                  | 21  | F.  | 440               | 2/2                   | 30   | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 30                  | 18  | M.  | 410               | 2/2                   | 40   | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 31                  | 25  | F.  | 400               | 2/2                   | 0  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 32                  | 21  | F.  | 400               | 2/2                   | 0  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 33                  | 8   | F.  | 390               | 2/2                   | 0  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 34                  | 22  | M.  | 390               | 1/2                   | 150  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 35                  | 20  | F.  | 370               | 2/2                   | 20   | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 36                  | 30  | F.  | 370               | 2/2                   | 0  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 37                  | 23  | F.  | 370               | 1/2                   | 100  | 2/2                    | 0                       | ..                    | ..                      | ..                     | ..                      |
| 38                  | 30  | F.  | 350               | 0/2                   | 390  | 2/2                    | 20                      | ..                    | ..                      | ..                     | ..                      |
| 39                  | 7   | F.  | 350               | 2/2                   | 0  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 40                  | 7   | F.  | 340               | 2/2                   | 20   | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 41                  | 45  | F.  | 310               | 1/2                   | 170  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 42                  | 11  | F.  | 310               | 1/2                   | 120  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| *43                 | 10  | M.  | 290               | 0/2                   | 450  | 0/2                    | 530                     | ..                    | ..                      | ..                     | ..                      |
| 44                  | 23  | F.  | 280               | 2/2                   | 0  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 45                  | 32  | F.  | 230               | 1/2                   | 130  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 46                  | 30  | F.  | 220               | 2/2                   | 0  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 47                  | 35  | M.  | 200               | 2/2                   | 0  | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 48                  | 10  | F.  | 140               | 2/2                   | 70   | 1/1                    | 0                       | ..                    | ..                      | ..                     | ..                      |
| 49                  | 18  | F.  | 140               | 2/2                   | 30   | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 50                  | 27  | F.  | 140               | 2/2                   | 90   | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| 51                  | 20  | F.  | 130               | 2/2                   | 50   | ..                     | ..                      | ..                    | ..                      | ..                     | ..                      |
| Total marks ..      |     |     |                   | 85/115 (74%)          | ..   | 25/34 (74%)            | ..                      | 9/12 (75%)            | ..                      | 2/3 (67%)              | ..                      |
| " groups 3 and 4 .. |     |     |                   | 27/37 (73%)           | Total whole series 121/164 = 73.8% (76 treatments) |                        |                         |                       |                         |                        |                         |
| " " 2 ..            |     |     |                   | 58/78 (74%)           |  |                        |                         |                       |                         |                        |                         |

\* This patient might have been reinfected but is retained in the series as the counts might be within the possible margin of error.

administered fasting in the morning after a preliminary glucose drink. In a few cases 3 c.cm. of carbon tetrachloride was similarly given without the chenopodium. The dose was regarded as a full dose for an adult man or well-built woman, but in these hills they only weigh 7 or 8 stones. Smaller doses were given to other women and to children. A scale of dosage we have been using latterly is 1 c.cm. of the above mixture for every 4 lbs. of body-weight which is almost exactly the same as 1 drachm per stone of body-weight.

This method of marking would seem to be fair to the method of treatment, whether in heavy or moderate cases of infestation, as the index is practically the same in both groups. But within any group there should be fairly even dispersal of cases, for it is obviously easier for a drug to score full marks by depressing a count from 100 to the group below than from 990 to the group below. In a large series this cancels out, and there is nothing to be gained by making the groups smaller, the groups as suggested being quite sufficient for clinical purposes. It is also interesting to note that almost the same index is obtained for second and third treatments. Here any reduction in efficiency that might be expected from drug-fastness of the worms is possibly offset by the fact that the first treatment in most cases reduces the count to the lower half of the group 2, so that there is no longer a random dispersal. Of course, this is too small a series from which to draw conclusions, but the efficiency index obtained in this way agrees with one's clinical impression of the efficacy of the method of treatment.

### Summary

1. A simple direct method of examining stools for hookworm and other helminth eggs is described by which eggs may be counted.

2. A modified glycerine-salt floatation technique is used with simple apparatus that can be made in any laboratory.

3. It seems sensitive as a qualitative method, so that no other examination for ova is made.

4. It has not been compared with standard methods of enumeration and it is stressed that it is intended for clinicians rather than research workers.

5. The results are sufficiently accurate to be of clinical value, and it is pointed out that great accuracy cannot be achieved by any method.

6. Using this method of egg counting as a basis a simple classification of grades of hookworm infestation is suggested.

7. The clinical value of egg counts is discussed.

8. A possible method of evaluating the efficacy of treatment is put forward, illustrated by a small series of cases.

In conclusion I would thank Dr. Stanley F. Thomas and Dr. Honor E. C. Wilkins for the

(Concluded at foot of next column)

## THE APPLICATIONS OF THE VITAMIN-C TEST FOR OVULATION IN THE DIAGNOSIS OF HORMONAL DISORDERS

By A. P. PILLAY, O.B.E., M.B., B.S.

Bombay 1

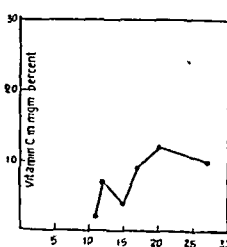
IN my first two papers on the subject (Pillay, 1940, 1940a), I explained how the vitamin-C test for ovulation can ascertain :—

(i) Whether a particular menstrual cycle is anovulatory, uniovulatory, or multiovulatory.

(ii) If ovulatory, the actual day of ovulation. The belief is still prevalent even among educated persons that conception can take place only just before or after menstruation. Knowing the day in a cycle on which alone the woman can conceive is most helpful in cases where the husband suffers from oligospermia and oospermia. I am utilizing this test in the series of sterility cases I am at present studying.

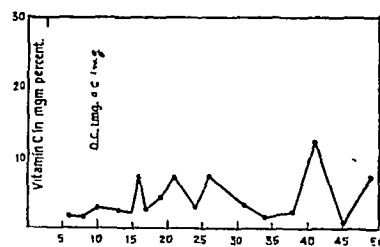
(iii) Whether a woman is pregnant. It was mentioned that a consistently high excretion of vitamin C in the urine of a woman who has missed her 'period' is an indication of pregnancy. Graph 1 is the urine chart of a pregnant woman and graph 2 that of a case of secondary amenorrhœa.

Graph 1.



Days of the cycle.

Graph 2.



Days of the cycle.

(iv) In incomplete abortion also, there is a consistently high excretion of vitamin C in the urine. Graph 3 is that of such a case. The test may, therefore, be useful to diagnose

(Continued from previous column)

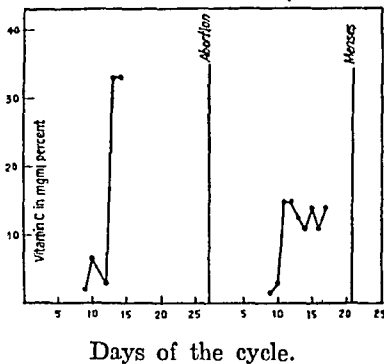
use of some of their cases, and all the staff of the hospital for their help. I would also gratefully acknowledge advice received from Professor Maplestone and Professor Ghosh of the Calcutta School of Tropical Medicine.

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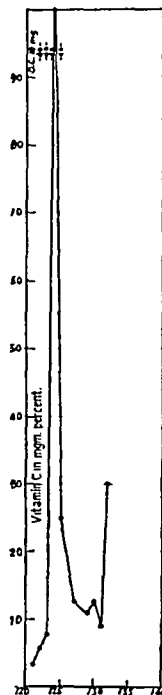
whether any pieces of placenta are left in the uterus in doubtful cases.

Graph 3.

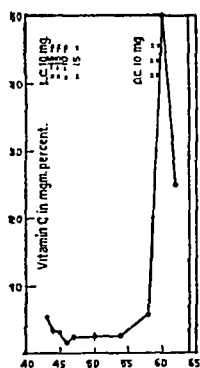


(v) It was mentioned in my last paper (Pillay, 1940a) that during the administration of oestrin, the excretion of vitamin C in the urine is *low*, while it is *high* when luteal hormone is administered. I find now that in pregnant women the effect of the administration of these hormones on the excretion of vitamin C in the urine is just the reverse, *i.e.*, when oestrin is administered the excretion is *high* and *low* when

Graph 5.



Graph 4.



Days of the cycle.

Days of the cycle.

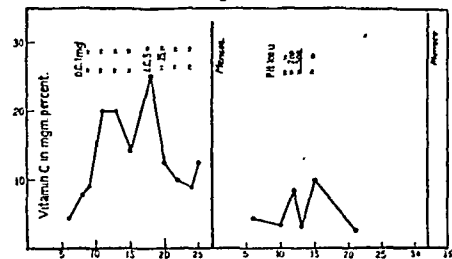
luteal hormone is administered. Graphs 4 and 5 illustrate this point. The vitamin-C test can, therefore, be used in two ways in diagnosing pregnancy.

(vi) There is, as far as I know, only one fallacy in using the test for diagnosing pregnancy, and that is in pituitary hypofunction where a similar picture is seen, *i.e.*, the excretion

of vitamin C is *high* when oestrin is administered and *low* when the luteal hormone is administered.

Graph 6 depicts two menstrual cycles of a woman of pituitary hypofunction. She was

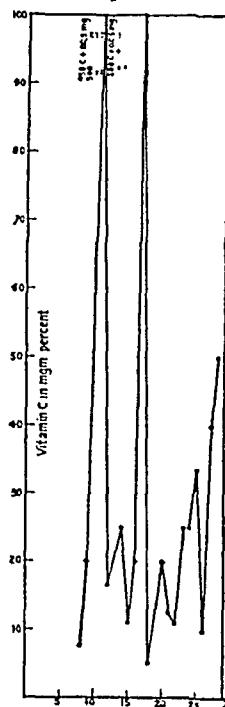
Graph 6.



Days of the cycle.

suffering from secondary amenorrhœa and the pituitary type of obesity. The last menses was two months previously.

Graph 7.



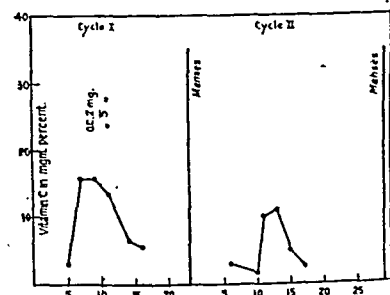
Days of the cycle.

In the first cycle ovcyclin P and leutocyclin were administered by injection consecutively and in the second cycle prehormon was given. It will be noticed that the latter exerted no influence on vitamin-C excretion. The treatment regularized her menses but the obesity remained the same.

Graph 7 is that of a normal case without any hormonal deficiency. In pituitary hypofunction the vitamin-C excretion is *low* in the luteal phase of the menstrual cycle, while, as was shown in my previous papers, it is comparatively *high* in normal cases.

Graph 8 is illustrative of this phenomenon.

Graph 8.

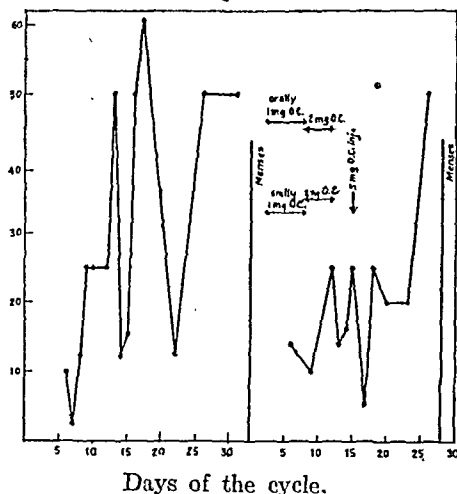


Days of the cycle.

Graph 9 is that of a case of sterility diagnosed in England as one of pituitary hypofunction. The vitamin-C tests showed anovulation in the

first cycle and when ovocyclin was administered in the second cycle, there was ovulation, proving conclusively that it was a case of hypogonadism and not of hypo-pituitarism. She became pregnant without any other treatment. The vitamin-C test thus helps in diagnosing pituitary hypofunction.

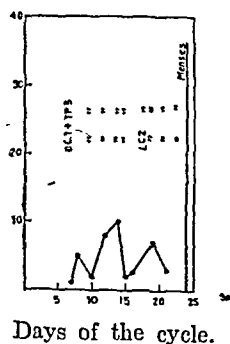
Graph 9.



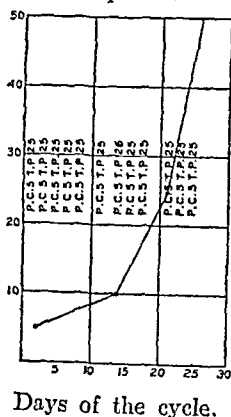
(vii) The graph (10) of a case of infantile uterus treated with a combination of ovocyclin P, lutocyclin and perandren is given.

(viii) In striking contrast to the above graphs is graph 11, that of a male while being treated for psychic aspermia (no seminal discharge) with perandren and percorten.

Graph 10.

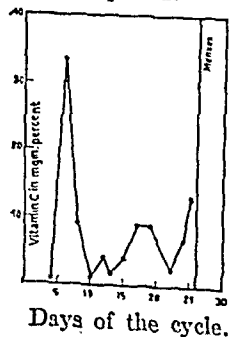


Graph 11.

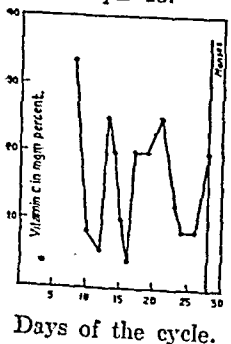


(ix) I have noticed during the course of my experiments a few atypical and irregular graphs. See graphs 2, 12 and 13. It may be mentioned

Graph 12.



Graph 13.



that in asthenia and constitutional disorders such graphs are common. See graph 12 which is that of a case of bronchitis.

There were other cases in which no constitutional cause was present. Curiously, such graphs were seen in cases where the menses were irregular and the menstrual cycle prolonged. They were also noticed in cases of sterility and in no case has the woman conceived in a cycle in which such irregularity was noticed. Such irregularity often alternates with the normal picture when conception is possible. The woman whose graph is no. 12 conceived two cycles later.

It was suggested that the atypical urine picture might be due to some substance present in the urine. Complete chemical and bacteriological investigation failed to show any substance likely to affect the dye solution. I am inclined to think that such cycles are anovulatory, caused by deficient follicular hormone, treatment with which usually brings the cycle to normal. The test is therefore helpful in diagnosing ovarian hypofunction. Out of 87 cycles studied, the irregular picture was seen in 19 cycles—5 cycles in women with irregular menses, 11 in cases of sterility and 2 in cases for which no explanation was possible. Out of 40 cycles of sterile woman studied, 11 cycles were irregular. It is believed that salicylates upset the vitamin-C test and such drugs are therefore forbidden.

(x) If the day of ovulation is known by the vitamin-C test, it can be utilized as a birth-control measure. I have discussed this subject in detail elsewhere (Pillay, 1941). Suffice it to say here that as multi-ovulation is possible in any cycle, the tests have to be carried out right through the end of every cycle.

*Explanatory note.*—In my previous papers, I offered no explanation why the vitamin-C test of urine for ovulation makes it possible to diagnose hormonal variations in the system. Even now I can think of no satisfactory explanation. In this paper one point stands out clear, viz, when prolactin is excreted in the urine, as in pregnancy, the tests show a picture just opposite to the normal.

The vitamin-C test and the interpretation of the graphs in this paper are the same as those described in my last.

In the graphs

C. stands for redoxon (Roche)  
O.C. " " ovocyclin P  
L.C. " " lutocyclin  
T.P. " " perandren  
P.C. " " percorten—all products of Ciba Ltd.

*Summary.*—The vitamin-C test for ovulation helps—

(i) in diagnosing pregnancy and incomplete abortion,

(Concluded on next page)

## TREATMENT OF CHOLERA WITH PYROGEN-FREE SALINE

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and

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*From the Cholera Bacteriological Inquiry, Indian Research Fund Association, School of Tropical Medicine, Calcutta)*

THE word 'pyrogen' literally means a substance that gives rise to pyrexia or fever when parenterally introduced into the body.

Pyrogens are filterable thermostable products of the growth of certain strains of bacteria falling within the group X described by Jordan. The organisms are ubiquitous and infect any water that is not kept absolutely sterile. They grow rapidly in distilled water; large quantities of pyrogens can be formed in a day at room temperature, and ordinary autoclaving does not destroy them. Water can be freed from them by distillation, but droplets should not pass over during the process. Pyrogens are readily destroyed by the addition of an acid or alkali to the water and the subsequent application of heat. They are particulate, the size being between 1 and 50 millimicrons and they contain nitrogen. Carter (1930) has described a test for pyrogens in water by boiling in dilute sulphuric acid and potassium permanganate solution, and has thereby indicated a method of preparation of pyrogen-free distilled water. Others have given a method of freeing water from pyrogens by shaking with charcoal.

The reaction produced by the injection of pyrogens is essentially characterized by rigor, and by feeling of chill. These may occur within 15 minutes or may be delayed up to 18 hours. The reaction is followed by profuse sweating and fall of temperature. There may be nausea, vomiting, headache and albuminuria. Death has sometimes occurred.

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(ii) in diagnosing pituitary and ovarian hypofunction, and

(iii) in the treatment of sterility.

No satisfactory explanation is possible as to why it is so.

*Acknowledgment.*—For this study redoxon and the dye tablets were supplied free of cost by Messrs. Hoffman La Roche and the hormonal products by Messrs. Ciba Limited.

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 D. V. Taraporevala Sons and Co., Bombay.

The use of saline made with pyrogen-free water for therapeutic purposes can be dated from 1937–38. Thomas and Ting (1938) used freshly distilled water for making saline for cholera cases and obtained no reaction. Knott and Leibel (1941), in their article 'Prevention of pyrexial reactions in intravenous therapy', indicated foreign protein as being the commonest cause of pyrexia. They found albuminoid ammonia present (from 0.005 to 0.025 per 100,000) in pyrogen-containing waters, and suggested 0.0002 per 100,000 as the safe limit.

Our experiments were done not to determine the nature of pyrogens but to see the effect of pyrogen-free hypertonic saline in cholera cases, as we found that in the Campbell Hospital, Calcutta, many cases treated with the hospital saline were getting severe rigor and pyrexia.

*Preparation of pyrogen-free distilled water.*—Distilled water was redistilled in an all-glass still in the presence of a few drops of strong sulphuric acid to make it faintly acid to litmus paper, and a few crystals of potassium permanganate were added to give it a faint pink colour during the whole process of distillation. The distillate was led through an adapter so that no drops could pass over into the receiver. The preparation of the receiver was important. It was made of Jena glass, 'Pyrex' or neutral, cleaned thoroughly with hot 10 per cent solution of potassium dichromate in 10 per cent sulphuric acid, washed with pyrogen-free distilled water and then autoclaved. The mouth of the receiver was covered with a clean wooden or cardboard disc with a central hole for the adapter to pass through. When sufficient pyrogen-free water was collected, it was measured in a clean sterilized cylinder and the required quantity of pure sodium chloride was added. The mouth of the receiver was either glass-stoppered or covered with a piece of clean, thick paper tied with a string round the neck, and the whole was immediately autoclaved. No rubber corks were used.

*Administration of the saline.*—Our apparatus consisted of a bottle in which two pieces of glass tubing were fitted through the rubber cork—one leading to the bottom of the bottle and attached by rubbing tubing to an intravenous needle or cannula at the distal end and the other fitted with a cotton plug for the entry of air only. The whole apparatus was sterilized in the autoclave. When it was used, a measured quantity of saline was poured into the bottle and a little was then blown out through the cannula. To ensure that the saline was running into the vein, a small U-tube, partly filled with a little sterile water, was fitted to the air entry tube. Bubbles of air aspirated through the U-tube indicated the rate of flow of the intravenous saline, which was regulated by raising or lowering the bottle. This device proved highly satisfactory for ready detection of the passage of saline. Rogers' flask can also be used after sterilization and washing with pyrogen-free water.

Pyrogen-free saline was used in 30 cases of clinically and bacteriologically proven cholera; freshly prepared distilled-water saline was used in 18 similar cases; and the hospital saline prepared in sterilized tap or distilled water was also used in 18 similar cases.

The results are given below :—

|   | Number of cases treated with pyrogen-free saline | Number of cases treated with freshly distilled water saline | Number of cases treated with hospital saline ordinarily prepared |
|---|--|---|--|
| 1. Rigor only   | 3 (10%)  | 1 (5.5%)  | 5 (27.8%)  |
| 2. Both rigor and high temperature.   | 1 (3.3%)   | 3 (16.6%)   | 12 (66.6%)   |
| 3. No rigor, no rise of temperature.  | 14   | 10  | 0  |
| 4. Rise of rectal temperature only 1°F., highest limit being 104.4°F.           | 6  | 3   | 1  |
| 5. Fall of temperature more than 1°F., lowest limit being 98.2°F. and no rigor. | 6  | 1, rigor +  | 0  |
|   | 30   | 18  | 18   |

The above table shows that with pyrogen-free saline in only one case were there both rigor and high temperature and that (14 + 6), i.e., 20 cases out of 30, had neither rigor nor rise of rectal temperature. On the other hand, out of 18 cases treated with hospital saline, 12 had both rigor and high temperature and all had either rigor or temperature. Pyrogens had been largely eliminated in the saline prepared in freshly distilled water and hence only 3 cases had both rigor and temperature and 10 cases out of 18 had neither.

As a rule the hospital saline is not used in cases showing rectal temperature above 100°F. Iced rectal saline is used first to bring down the temperature and then intravenous saline is administered so as to minimize the risk of complications. Pyrogen-free saline, however, was used by us in 11 cases with a high rectal temperature, without any untoward effects.

The results are given in the following table :—

|  | Pyrogen-free saline |
|--|---------------------|
| 1. Rise of rectal temperature ..                     | 0                   |
| 2. No rise or fall of temperature and no rigor .. .. | 6                   |
| 3. Fall of temperature and no rigor                  | 5                   |
| TOTAL ..   | 11 cases            |

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## NYLON

By F. V. STONHAM

MAJOR, I.M.S.

NYLON is a synthetic textile produced by a process of polymerization from such unromantic raw materials as coal, water and air. It is a substance of remarkable strength, elasticity, and flexibility. It is almost completely waterproof, resistant to heat and unaffected by a large number of chemical substances. Various fine fabrics, stockings, etc., made from this substance were found to be extremely resistant to wear and rough treatment in the laundry, and fishing lines made from it were found to be capable of being stored in a wet condition for long periods without deterioration. Its properties suggested that it might be of value in surgery as a suture material, and it has now been placed on the market by the American firms, Davis and Geck, A. J. Deknatel and Son, Bauer and Black, and more recently I. C. I. (Plastics), Ltd., have manufactured it in England for surgical purposes.

Nylon has the following advantages :—

1. It is of great strength.
2. It is insoluble and able to take up minute quantities of moisture only.

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It will be seen that there was no rise of rectal temperature in any case. On the contrary, in about half the cases, the high rectal temperature came down giving comfort to the patients. Rigor was absent in all the eleven cases.

### Summary

1. Pyrogen-free water is prepared by mixing water with a little sulphuric acid and potassium permanganate and then distilling the mixture in an all-glass still. Water is collected in a specially prepared receiver. The saline is prepared with this water and immediately sterilized, and can be stored.

2. The saline is given in cholera cases, with a suitable outfit, indicating its regular inflow.

3. The pyrogen-free saline gave rise to rigor or hyperpyrexia in only a small proportion (13.3 per cent) of cases, whereas the pyrogen-containing saline prepared with sterilized water produced the pyrogenic reactions in 94.4 per cent of cases.

4. Pyrogen-free saline can safely be administered in cases with a high rectal temperature.

Our thanks are due to Dr. B. C. Chatterjee, the officer-in-charge of the cholera ward of the Calcutta Campbell Hospital, for kindly giving us all facilities for work on his cases and taking a keen interest in our experiments.

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3. It appears to be unaffected by repeated boiling, or repeated dry sterilization, or by antiseptics (except phenol).

4. It appears to have no deleterious effect on tissues and it is unaffected by digestive enzymes.

5. It can be readily knotted even when dry, and the knots have little tendency to slip except in the case of the largest sizes.

6. It can be provided in any length and is therefore useful for closure by continuous suture of wounds, however large.

7. The calibre is perfectly even and cylindrical and there are no weak spots as are commonly found in silkworm-gut.

8. It possesses moderate elasticity.

Nylon is obtainable in two forms. It can be made into a solid gut-like cylinder as a substitute for silkworm-gut, or fine threads may be woven into a braided thread similar to braided silk.

Trial supplies were kindly placed at the disposal of the writer by the firms alluded to above. Solid nylon filaments were used for tension sutures, and for skin closure by various methods of stitching, including subcuticular sutures, in a variety of operations, with complete satisfaction. There was no irritation around the stitch holes, and the material knotted readily, and the knots had no tendency to 'give' except in the coarsest sizes, in which this was overcome by using the triple knot. Knots could be roughly tied and tightly pulled without any breakage occurring. Silkworm-gut of approximately equal size breaks readily with similar treatment. By using long lengths on the needle, interrupted sutures could be inserted with a minimum of wastage. For this reason it is unfortunate that I. C. I. (Plastics), Ltd., supply their product cut up into 14-inch lengths.

Braided nylon thread was similarly used for skin closure with complete satisfaction.

Though a woven thread is inevitably porous, the non-hygroscopic nature of the material combined with 'hard' braiding reduced this feature to a minimum, and there is no practical disadvantage. Wounds were closed using nylon silk and silkworm-gut in the same wound. It was observed that there was a minimum of redness around the silkworm-gut and nylon, but there was distinctly more redness around the silk.

Nylon thread was also used for buried sutures without apparent ill effect and in operations including appendicectomy, cholecystectomy, nerve suture, radical cure of hernia, meniscectomy. Repair took place normally and there were no undesirable after-effects of any kind, though nylon was used exclusively. Removal of nylon sutures was painless and the wound scars were inconspicuous.

Sutures of solid and braided nylon together with silkworm-gut and silk were placed in an animal and removed for section after ten days. There appeared to be less tissue reaction around

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## MOUSE PROTECTION TEST AS A METHOD OF DIAGNOSIS OF WEIL'S DISEASE—A CONTRADICTION

By B. M. DAS GUPTA

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LARSON (1941) has pointed out that young mice (*Mus musculus*) are extremely susceptible to *Leptospira icterohæmorrhagiae*. The mortality rate is approximately 100 per cent in the 3-week-old mice. As the cost of mice is much less than that of guinea-pigs and death occurs in them as early as, or earlier than, in guinea-pigs, they can be used for diagnostic inoculation in suspected cases of Weil's disease. But according to the same worker, most observers who have previously studied the question of susceptibility of white mice have expressed the contrary opinion. Possibly not being particular about the age of the experimental mice, they have used full-grown animals which are almost insusceptible to *L. icterohæmorrhagiae*. In view of the importance of Larson's observations, it was thought worth while to investigate the susceptibility or otherwise of young white mice to Indian strains of *L. icterohæmorrhagiae*.

### Materials and methods

The strain of *L. icterohæmorrhagiae* used for the first two experiments to be reported in this paper was isolated in September 1937 by culture of blood from a severe case of hæmorrhagic jaundice. It is an extremely virulent strain, guinea-pigs having succumbed to the infection following intraperitoneal injection of 0.5 c.cm. of the culture, in about a week. The culture was initiated on Fletcher's medium and has since been continued in Vervoot's medium.

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the nylon than around the other sutures. In one case, a sciatic nerve had been sutured with fine braided nylon. The ends of the nerve had been sutured under tension with considerable difficulty, and six months later the wound was re-opened in order to resect a further portion of nerve and re-suture. Healing of the nerve sheath had been good and there was no reaction around the nylon sutures, and nothing was adherent to the knots. A neuroma was present which was anticipated, since it had been impossible to resect as much nerve as desirable in the original operation.

In the opinion of the writer after nearly two years' trial, nylon, as a suture material, is markedly superior to both silk and silkworm-gut. It can be used in almost any kind of clean wound. The solid strands are excellent for skin closure, while the fine braided thread, on account of its great strength and durability, makes it particularly suited to ophthalmic, nerve, and plastic surgery, or, in fact, any delicate work.

The virulence of the strain has been maintained and enhanced by passage through young guinea-pigs approximately every third week. The spirochæte gave a titre of 1 in 10,000 with Wijnberg\* antiserum.

For the third series of animals another strain was used. It was recovered from a case of Weil's disease by inoculation of urine into a guinea-pig on the very day of the commencement of the experiment. Three series of animals were experimented upon.

#### Series 1 and 2

A litter of 6 mice (*Mus musculus*), born 20 days previously, were selected. As Larson (*loc. cit.*) has noted that young mice tolerate at least 0.6 c.cm. of infected material administered intraperitoneally, these mice all received the same dose of a rich culture, the injection being given very slowly into the peritoneum.

The results are shown in the table.

On the seventh day of inoculation 2 of the survivors developed marked jaundice, particularly pronounced in the ears, tail and pads of the feet. Their peritoneal fluid was also coloured yellow, but showed no leptospira.

All the animals succumbed to leptospiral infection, leptospiræ being present in considerable numbers in the liver and kidneys, especially in the liver.

#### Series 3 and 4

Three 18-day-old mice and an equal number of guinea-pigs, weighing 102, 108, and 115 grammes respectively, were inoculated with a guinea-pig's liver emulsion containing a good number of leptospiræ. 0.6 c.cm. of the supernatant fluid from the 10 per cent emulsion was injected intraperitoneally into all these animals.

The results are shown in the table.

One of the surviving mice became definitely jaundiced on the 5th day but 3 days later it appeared quite normal again.

#### Series 5 and 6

A batch of four 21-day-old mice and 4 young guinea-pigs weighing less than 120 grammes were used in this series. These animals were also inoculated with the same dose as in the two previous experiments. The infective material consisted of liver and kidney emulsions of a

TABLE

| Series | Animals used | Number dying: by days |     |     |     |     |     |     | Number surviving after 3 weeks | REMARKS   |
|--------|--------------|-----------------------|-----|-----|-----|-----|-----|-----|--------------------------------|---|
|        |              | 1st                   | 2nd | 3rd | 4th | 5th | 6th | 7th |                                |   |
| 1      | Mice         | ..                    | 1*  | ..  | ..  | ..  | ..  | ..  | 5                              | * Probably death was due to trauma caused by faulty inoculation.  |
| 2      | Guinea-pigs  | ..                    | ..  | ..  | 1   | 4   | 1   | ..  | ..                             | All died.   |
| 3      | Mice         | ..                    | ..  | ..  | ..  | 1*  | ..  | ..  | 2                              | * Died of leptospiral infection. Scanty leptospiræ found in the liver.  |
| 4      | Guinea-pigs  | ..                    | ..  | ..  | 1   | 2   | ..  | ..  | ..                             | All died of leptospiral infection.  |
| 5      | Mice         | ..                    | ..  | ..  | ..  | ..  | 1*  | ..  | 3                              | * This mouse became intensely jaundiced and died apparently of leptospirosis. The body was in an advanced stage of decomposition when seen next morning, rendering the autopsy useless. |
| 6      | Guinea-pigs  | ..                    | ..  | ..  | 1   | 1   | 2   | ..  | ..                             | All died.   |

Icterus, however, disappeared completely 4 days later and the animals looked quite healthy again.

At the same time 6 young guinea-pigs, weighing between 95 and 108 grammes, were inoculated in exactly the same manner, except that 2 animals received smaller quantities (0.5 and 0.42 c.cm. respectively), as an adequate quantity of the inoculum was lacking.

The results are shown in the table.

guinea-pig infected with the urine from a case of Weil's disease.

The results are shown in the table.

Two of the surviving mice developed slight jaundice which passed off after two days.

In the case of the guinea-pigs, every death was due to leptospiral infection, spirochætes being invariably found in the organs.

#### Summary and conclusion

Thirteen young white mice (*Mus musculus*) varying in age from 18 to 21 days and an equal

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\* Wijnberg strain = a classical strain of *L. icterohæmorrhagiae*.

# CAN THE DETERIORATION OF ERGOT EXTRACTS BE PREVENTED IN THE TROPICS ?

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and

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MUKERJI (1938) reported that a very large proportion (86.13 per cent) of the ergot extracts examined at the Biochemical Standardization Laboratory was below strength and many specimens of this series were found to contain either a trace of or no active alkaloids at all. Bose, Dey and Mukerji (1941) studied the keeping properties of liquid preparations of ergot (*B. P.* 1932 and *B. P.* 1914 formulæ preparations) under various conditions of storage, exposure and hydrogen-ion concentration and came to the conclusion that samples of liquid extract of ergot, if kept at a pH in the neighbourhood of 3, and at low temperature inside a refrigerator, would undergo deterioration at a much less rapid rate than under ordinary conditions of storage in room temperature exposed to light. In view of the importance of ergot extracts in obstetrical practice in India, it is obviously of importance to discover ways and means by which ergot extracts could be stabilized under the climatic conditions existing in the tropics. Liquid extract of ergot is still the mainstay of the physician and though it is gradually being replaced in city hospital practice by the standardized active alkaloids of ergot, it is the drug of choice with the midwives in rural areas of India who can employ it in suitable cases of post-partum hæmorrhage without consulting the physician. The present investigation was taken up with a view to finding out if liquid extracts of ergot can at all be stabilized by the addition of certain chemical agents which are known to prevent deterioration in similar pharmaceutical preparations.

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number of young guinea-pigs weighing less than 120 grammes were inoculated with virulent *Leptospira icterohæmorrhagiae*. All the guinea-pigs succumbed to the infection between the 4th and 6th days, whereas only two mice died of the infection on the 5th and 6th day. These experimental results clearly demonstrate the fact that even young specimens of white mice are much less susceptible to Indian strains of *L. icterohæmorrhagiae* than young guinea-pigs and therefore on no account can they be regarded as suitable for protection tests in the detection of Weil's disease in this country.

## REFERENCE

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## Experimental

A. *Method*.—A sample of liquid extract of ergot (approximate 2 litres; pH 2.5) was prepared according to the method laid down in *B. P.* 1932. The total alkaloidal content of this sample was determined and it was then divided into 6 equal parts. To each of these aliquots, the following reagents were added in the proportions shown against each :—

(1) An anti-oxidant, e.g., hydroquinone 1.0 per cent.

(2) A stabilizing agent, e.g., metaphosphoric acid, 0.5 per cent.

(3) An antiseptic agent, e.g., merthiolate (sodium ethyl mercurithiosalicylate), 0.01 per cent.

(4) A reducing agent, e.g., ascorbic acid, 0.1 per cent.

(5) A reducing agent, e.g., ascorbic acid, 0.5 per cent.

(6) Control (without any reagent being added).

The six samples, thus treated, were then divided into two lots each. One set was kept in a refrigerator at 6° to 8°C. and the other set was maintained as usual under ordinary conditions in the laboratory shelf. Monthly determinations of the alkaloidal contents of these twelve samples were carried out regularly for the next 7 months.

In determining the total alkaloidal contents, the colorimetric method outlined in *B. P.* 1932 with the modification outlined in the *Addendum*, 1936, was employed all through, the colour comparisons being made with the help of a Zeiss Pulfrich photometer.

B. *Laboratory findings*.—The results obtained are expressed in tabular form (see tables I and II). It will be seen that conditions of treatment of the samples remaining the same storage at a low temperature in the refrigerator has a distinct influence on the rate of deterioration of liquid extracts of ergot. Another observation of significance is that none of the

TABLE I  
Samples kept at ordinary room temperature  
(20° to 35°C.)

| (1)            | (2)                          | (3)                                   | (4)                            | (5)                             | (6)                             |
|----------------|------------------------------|---------------------------------------|--------------------------------|---------------------------------|---------------------------------|
| Control sample | With 1 per cent hydroquinone | With 0.5 per cent metaphosphoric acid | With 0.01 per cent merthiolate | With 0.1 per cent ascorbic acid | With 0.5 per cent ascorbic acid |
| 59.83          | 59.83                        | 59.83                                 | 59.83                          | 59.83                           | 59.83                           |
| 47.40          | 50.13                        | 48.77                                 | 46.03                          | 55.87                           | 59.83                           |
| 42.35          | 41.17                        | 36.06                                 | 38.79                          | 52.86                           | 57.10                           |
| 30.33          | 25.54                        | 26.64                                 | 28.41                          | 46.03                           | 46.72                           |
| 24.72          | 20.35                        | 22.95                                 | 24.72                          | 42.35                           | 44.80                           |
| 24.72          | 13.25                        | 17.08                                 | 21.17                          | 36.61                           | 44.80                           |
| 19.12          | 13.25                        | 17.08                                 | 17.89                          | 32.37                           | 39.89                           |
| 13.25          | 8.33                         | 11.06                                 | 13.93                          | 26.50                           | 37.70                           |

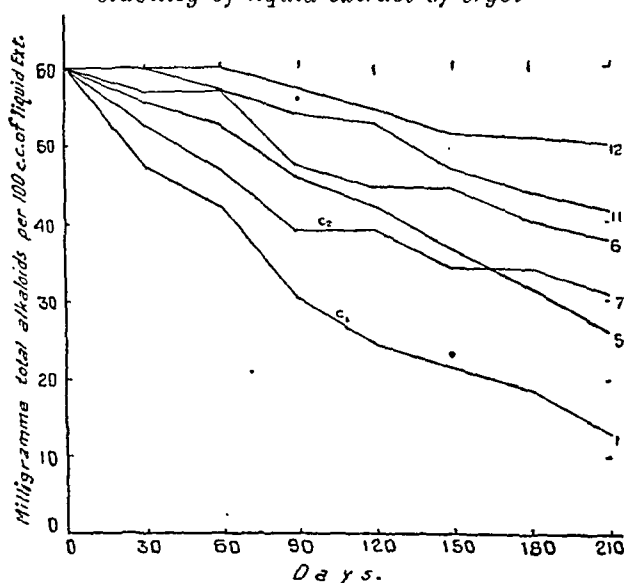
TABLE II  
Samples kept in frigidaire (6° to 8°C.)

| (7)            | (8)                          | (9)                                    | (10)                           | (11)                            | (12)                            |
|----------------|------------------------------|--|--------------------------------|---------------------------------|---------------------------------|
| Control sample | With 1 per cent hydroquinone | With 0.5 per cent meta-phosphoric acid | With 0.01 per cent merthiolate | With 0.1 per cent ascorbic acid | With 0.5 per cent ascorbic acid |
| 59.83          | 59.83                        | 59.83                                  | 59.83                          | 59.83                           | 59.83                           |
| 52.86          | 54.37                        | 57.37                                  | 54.37                          | 57.10                           | 59.83                           |
| 47.40          | 54.37                        | 46.03                                  | 50.13                          | 57.10                           | 59.83                           |
| 39.34          | 54.37                        | 43.57                                  | 44.12                          | 54.09                           | 54.37                           |
| 39.34          | 48.77                        | 39.89                                  | 37.70                          | 52.86                           | 54.37                           |
| 34.42          | 44.12                        | 34.42                                  | 36.61                          | 47.40                           | 51.50                           |
| 34.42          | 44.12                        | 34.42                                  | 35.52                          | 44.12                           | 50.82                           |
| 30.33          | 40.57                        | 30.33                                  | 31.83                          | 41.12                           | 50.13                           |

N.B.—The figures indicate mg. of total alkaloids of ergot per 100 c.cm. of the liquid extract.

stabilizing agents except ascorbic acid has any demonstrable influence on the rate of deterioration. The influence exerted by ascorbic acid on ergot extracts is well marked both in room temperature as well as in the refrigerator, a strength of 0.5 per cent being more suitable to prevent rapid deterioration. The graph below brings out the point very clearly.

Graph showing influence of ascorbic acid on the stability of liquid extract of ergot



- (1) Control sample (C<sub>1</sub>) in room temperature.
- (2) Control sample (C<sub>2</sub>) in refrigerator.
- (3) Ergot extract with 0.1 per cent ascorbic acid in room temperature.
- (4) Ergot extract with 0.5 per cent ascorbic acid in room temperature.
- (5) Ergot extract with 0.1 per cent ascorbic acid in refrigerator.
- (6) Ergot extract with 0.5 per cent ascorbic acid in refrigerator.

Note how the deterioration is prevented by ascorbic acid even when maintained at room temperature. In the refrigerator with 0.5 per cent ascorbic acid (no. 12), the rate of deterioration is markedly checked.

### Summary and conclusions

(1) Attempts have been made to check the rapid rate of deterioration of liquid extract of ergot (B. P. 1932) in tropical climates by the addition of preservatives, anti-oxidants and reducing agents such as hydroquinone, meta-phosphoric acid, merthiolate (sodium ethyl mercurithiosalicylate) and ascorbic acid.

(2) Ascorbic acid is the only agent which has a demonstrable effect on the stability of liquid extracts of ergot. Though 0.10 per cent is effective, 0.5 per cent has a much better action in this respect.

(3) In the interest of the consumers and in the interest of scientific and medical practice, liquid extracts of ergot should not be allowed to be stored haphazardly under ordinary conditions exposed to heat and light. Even under the best of conditions of manufacture (i.e., prepared from a good and potent batch of ergot and the extract maintained at a pH level of about 2.7), ergot extracts deteriorate rapidly in 7 to 10 months from the time of its preparation. This may be largely checked by the addition of ascorbic acid in 0.5 per cent concentration. Ethical manufacturers may help the cause of medical practice a great deal by adding ascorbic acid in adequate concentration to their liquid extracts of ergot and by advising pharmacists to store these in a cool place, or better in a refrigerator, wherever available.

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## A Mirror of Hospital Practice

### IMPERFORATE EXTERNAL URINARY MEATUS IN A NEW-BORN CHILD

By S. KUNDU, M.B., A.M.S.

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In November 1941 a male child was brought to me at the civil hospital, Silchar, with the history that it had not passed any urine since its birth 36 hours previously. The child was delivered in the maternity ward of the Siva Sundari Nari Sikhyasram, Silchar.

The child did not appear to be in any distress nor were there any signs of bladder distension. There were no signs of urine having been passed per rectum and this was confirmed on examination, which showed no internal or external vesical fistula. The corona glandis was well formed, but the prepuce was absent and a slight depression could be seen at the meatal site.

With a cataract knife a small incision was made at the depression and after going through a membrane one-sixth of an inch thick, the urethral cavity was entered.

A no. 1 rubber catheter introduced through the incision was passed into the bladder without difficulty and 2 drachms of light-coloured urine came away. No anaesthesia was required for the operation.

The incision was kept patent by passing a catheter three times a day for three days. The child was discharged after ten days, during which urine was passed without any trouble. Further reports are that the child is quite well.

No other developmental abnormalities were found.

This is the first case of the kind we have encountered in 25 years of hospital and private work.

My thanks are due to Lieut.-Colonel E. T. N. Taylor, I.M.S., for kindly permitting me to publish this note, also to Dr. R. Chowdhury for sending the case to us, and to Dr. S. K. Dutta and Mrs. I. Roy for helping in diagnosis and operation.

## A STRANGULATED PARADUODENAL HERNIA

By M. V. RAJAPURKAR, L.M.P. (C. P.)

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*History.*—On the 24th September, 1941, M., a Hindu male, aged 40, was admitted to hospital with a history of severe gripping pain in the upper abdomen for two days and inability to pass faeces or flatus for the last 12 hours. No history of previous illness. He had vomited twice during the last 3 hours, and had a feeling of nausea and severe thirst.

*Physical examination.*—The patient was very restless and complained of severe gripping pain in the abdomen, particularly in the epigastrium.

Temperature—99°F.

Pulse—110 per minute, small in volume and low in tension.

Respiration—36 per minute, mainly thoraco-abdominal.

Tongue—dry and furred.

Abdomen—there was a fullness in the upper abdomen, particularly in the epigastrium. The abdomen was soft but not tender. Auscultation of the abdomen revealed no signs of increased peristalsis.

Liver dullness—present, normal.

Hernial orifices—normal.

Rectal examination—nothing abnormal detected.

Nervous system—nothing abnormal detected.

Heart and lungs—nothing abnormal detected.

A definite conclusion could not be arrived at so it was decided to watch the patient. Meanwhile the following treatment was carried out:—

At 11 a.m.—(a) A high compound enema was given with poor result.

(b) Glucose solution 25 per cent 50 c.cm. was given intravenously.

(c) Morphine hydrochloride gr.  $\frac{1}{4}$  and atropine sulphate gr.  $\frac{1}{100}$  was injected subcutaneously.

At 12 noon.—A high compound enema was repeated with no result.

At 12 p.m.—The patient was obviously very ill and becoming worse. The pulse was now 122, small in volume and low in tension and so the case was taken to the table with a provisional diagnosis of intestinal obstruction.

*Operation.*—Under chloroform anaesthesia a right paramedian incision was made and the abdomen opened in the usual way. The part of the ileum near the caecum presented in the incision. The caecum and the appendix were normal. On tracing the intestine upwards for about a foot it was found collapsed, which could be traced to the paraduodenal fossa. The margin of the paraduodenal fossa was stretched by a finger

and the whole of the jejunum and part of the ileum was released from the strangulation. The gut was found to have twisted round itself. The gut having been released the mouth of the sac was stitched. The intestines were healthy. Flatus tube was passed on the table with good results.

*Post-operative treatment.*—(1) Fowler's position in bed. (2) Liquid diet. (3) Intravenous glucose 25 per cent 40 c.cm. was given twice daily for two days. (4) Pitressin 0.5 c.cm. was given every 6 hours for the first 24 hours. (5) Morphine hydrochloride gr.  $\frac{1}{4}$  and atropine sulphate gr.  $\frac{1}{4}$  was injected subcutaneously twice daily for two days.

The patient made an uneventful recovery. The wound healed by first intention and he was discharged cured on the 14th October, 1941.

*Comment.*—In view of its extreme rarity a brief account of the applied anatomy and the mechanism of formation of these herniae is given.

A paraduodenal fossa is very rarely present, but when present it is larger than others. Its mouth looks medially and its free crescentic margin which may be 2 inches long communicates with the lateral extremities of the free borders of the superior and inferior fossa when present. The inferior mesenteric vein runs upwards in its anterior wall and the ascending branch of the left colic artery may occupy a similar position or may lie along its lateral margin. When a hernia enters this fossa it carries its sac downwards and laterally behind the posterior parietal peritoneum and the vessels already mentioned, but in front of the left ureter or kidney.

Normally it is occupied or filled by the convexity of the terminal part of the duodenum to which it serves as a bursa. The commencement of the jejunum presses into the fossa, enlarges its cavity and ultimately separates the peritoneum from its posterior attachment. It may spread in one or all three directions, to the right behind the duodenum, to the left behind the inferior mesenteric vein or upwards behind the suspensory ligament and the root of the transverse mesocolon. More and more of the small intestine passes into the increasing pouch until at last the whole of the small intestine may be found lodged in an enormous median retroperitoneal sac, the mouth of which is the orifice of the fossa duodeno-jejunalis.

Interesting features of the case are:—

1. It bears testimony to Lord Moynihan's statement—'It will perhaps be found that acute intestinal obstruction is not so much due to an actual compression at the neck of the sac as to a volvulus of the bowel; all gut in the hernial sac is twisted round the entering and returning loops'.

2. In these cases there is often abdominal tenderness and rigidity owing to extravasation of blood in the peritoneum. It was an absent feature in this case.

3. Coprostasis is an indefinite sign of intestinal obstruction and should not be relied upon for diagnosis or treatment. (The patient's bowel had moved 12 hours before admission to the hospital.)

# Indian Medical Gazette

MAY

## THE LEPROSY PROBLEM

THE war has added to the many medical and social problems that have to be faced daily, and it has inevitably tended to push the old ones into the background, but most of our old problems are still with us, and, even if we are too busy to face them properly now, they will have to be faced sooner or later in the new, and we hope improved, social order that will arise after the war. We have been reminded of one such problem by the issue of the report, by a committee of the Central Advisory Board of Health, on *Leprosy and its Control in India*.

The popular conception of leprosy, in many countries in Europe at least, is that it is a most highly infectious disease which is liable to develop after a single contact with a leper, and that one rapidly becomes white all over and one's limbs periodically drop off. Traditional influences, especially that of the bible, have been responsible for this, and the medical profession has for many years attempted to dispel this altogether erroneous impression, as an important step towards the development of a more rational attitude towards leprosy on the part of the general public. The unreasonable fear of infection has in the past led to the neglect of and the infliction of unnecessary cruelties on the victims, which in turn has led to concealment.

The extreme infectiousness of leprosy was first questioned about the middle of the last century. In 1862 a committee of the Royal College of Physicians of London found no evidence that leprosy was communicable, but a majority considered it to be hereditary. A few years later, the Indian Leprosy Commission of 1890, despite the otherwise practically unanimous opinion on the infectious nature of the disease, which naturally followed the discovery of the lepra bacillus in 1872, adopted the unique view that leprosy was not hereditary, and that, though technically it was infectious, it was seldom so transmitted, but was generated *de novo* in persons living in insanitary surroundings. Since this date, however, no authoritative body has questioned the infectiousness of leprosy, but it has been clearly shown that the degree of infectiousness is very low, and that, even after continuous and close contact over a long period, transmission to an adult is often not effected; for instance, in 95 per cent of instances leprosy in a husband or wife is not transmitted to the other partner. On the other hand, children are extremely susceptible; a very large percentage of children left with leprosy parents develop the disease. During recent years, the problem of hereditary transmission has been clarified; all the evidence points to the conclusion that there is no hereditary transmission, for, if children of

leprosy parents are removed from these parents at birth, they practically never develop leprosy.

This clarification of the question of the infectiousness of leprosy has made it possible for the general public and the medical profession to take a much more reasonable view of the leper problem, in place of the extreme panic or the extreme indifference with which it has been viewed at different times in the past. There seems to be no question that isolation, and preferably institutional isolation, of all infectious cases and of all cases likely to become infectious, is the best solution; the real problem is to decide how this isolation can best be done under the prevailing conditions.

To carry out a scheme of institutional isolation in India would mean institutional accommodation for a quarter of a million patients, whereas at present accommodation for only 14,000 is available. If more accommodation were available, it is believed that much of this isolation could still be achieved on a voluntary basis, except with regard to leper beggars, and here compulsion is absolutely necessary. In large towns leper beggars are a serious menace to public health; though it may be true that many of the most crippled beggars are 'burnt-out' cases and therefore not infectious, a big percentage of beggars are highly infectious. In this matter, public sentiment is much to blame. If the public could be impressed with the fact that every pice given to a leper beggar helps to keep alive an active source of infection for themselves and their children, whereas that same pice given to an institution for destitute lepers would help to remove this source of infection, they would realize that by giving way to sentiment, the alms-giver commits a double crime against society and himself.

Another line of attack—we will not say 'a second line' because many will place it first—is the early removal of infants from leper parents. Could this be done systematically and efficiently, it seems probable that leprosy would be markedly reduced within a generation or two. If unrestrained propagation were allowed in leper colonies, the problem of dealing with the children would become an even more serious one than the maintenance of the colonies themselves. This question of birth control amongst lepers is an aspect of the problem that does not seem to have been emphasized in the very comprehensive report that we referred to at the beginning of this editorial, beyond a suggestion that married life should not be allowed in institutions unless the woman has passed the child-bearing age, which is not facing the problem at all, but only rather feebly sidetracking it; however, it is obviously an aspect that will eventually have to be faced.

One of the first and most important steps in the solution of the problem of leprosy, in India, in particular, is education. Let us not delude ourselves that this is outside our scope, for where this education is most needed is in our medical schools and colleges. We believe that the



student is no longer taught that the disease arises *sui generis* or *de novo*, but the attitude is certainly that it is *ultra vires*, as far as the general medical curriculum is concerned; if you suspect leprosy you call in a specialist or send the patient to the nearest leprosy clinic; otherwise, you do nothing about it, except avoid contact with the patient yourself. This has we are afraid too often been the advice given to the student and young practitioner. The leprosy problem is very largely a socio-economic one, but this matter of medical education is a direction in which the medical profession can help without outside assistance.

Attention is drawn in this report to the very useful leprosy courses that are being held from

time to time at the Calcutta School of Tropical Medicine and elsewhere, under the auspices of the British Empire Leprosy Relief Association. These, however, should be looked upon largely as an interim measure to help to remedy an obvious defect in medical education in this country; when the teaching in these courses has filtered through to the medical schools and colleges, they will have achieved one of their main objects.

The report issued by the Central Advisory Board of Health gives a very excellent account of the leprosy problem in India, past, present and future. We propose to reprint the summary and recommendations with which this report concludes, in our next issue.

## Special Articles

### ALCOHOLIC BEVERAGES IN INDIA

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#### PART II

#### *Consumption of country spirits and beers in different provinces*

IN this section an attempt is made to review the present position of the use of different alcoholic beverages in different provinces with special reference to the conditions which determine their consumption in these areas.

1. *The Bengal Presidency.*—The consumption of country liquor in 1936-37 was 364,589 proof gallons which amounts to 73 proof gallons per thousand of the population. The name 'country spirit' in Bengal applies to unsophisticated spirit made locally from mohua and molasses. The standard strength varies from 25 degrees and 75 degrees underproof. The causes which determine the consumption of alcoholic drinks in this presidency are the comparatively small urban population, especially towards the west, the fair percentage of Mohammedans chiefly in the eastern districts, and the large industrial population extending from Calcutta to Asansol in the north-west along the railway lines and in the coalfields. From a careful survey of the consumption of spirits in different areas it has been concluded that the presidency can be divided into three district zones: (1) the town of Calcutta, its suburbs, and the adjoining industrial areas of Burdwan and Hooghly; (2) the Darjeeling district and the adjoining tea gardens; and (3) the Eastern Bengal zone comprising the

Dacca division, populated mostly by Muslims (67 per cent). This area is mainly agricultural, and therefore the consumption of alcohol is, on the whole, much lower here than in the other parts of the province.

*Pachwai* or *handia* or *marua*, i.e., fermented liquor brewed from rice or millet, is drunk chiefly by the aboriginal tribes in several districts and is used both as a stimulant and as a food. It is the favourite drink of the lower classes, particularly the aboriginals. Except in Darjeeling, where *pachwai* is chiefly made from millet, rice is mainly used for its production. Free home-brewing of *pachwai* is permitted only for private consumption to the aboriginal tribes in a few districts during the annual *Bandhana* and *Pous Sankranti* festivals. *Wanchu*, a variety of fermented liquor, prepared from rice, is sometimes used by the Chinese in Calcutta on ceremonial occasions for which temporary permission is obtainable.

TABLE VI

Number of licences issued for retail sale home-brewing and manufacture of *pachwai* on special occasions in Bengal Presidency:—

|                                  |    |    |        |
|----------------------------------|----|----|--------|
| Retail                           | .. | .. | 1,145  |
| Home-brew                        | .. | .. | 61,406 |
| Manufacture on special occasions | .. | .. | 633    |
| TOTAL                            |    |    | 63,184 |

The migration of the aboriginal tribes to Burdwan, Birbhum, Bankura and Murshidabad districts, which adjoin Chota Nagpur and Behar, has spread the use of *pachwai* all over this province, especially in the western and northern districts bordering the Chota Nagpur hills and the Himalayas. In the northern and eastern parts of Bengal, comprising the Darjeeling district, Sikkim and Bhutan borders, the use of a different kind of beer called *marua* is in vogue.

2. *Behar.*—The consumption of country liquor during the year 1939-40 amounted to 640,426.5 proof gallons, roughly 3 proof gallons per 1,000 of the population. Country liquor is mostly consumed in Patna division, in two districts of Bhagalpore division and in two districts

of Chota Nagpur division. The districts of Patna and Arrah form part of a compact and well-defined alcohol-consuming area which includes the adjoining Benares and parts of Allahabad divisions and almost the whole of the Oudh in the United Provinces. The cause of the high consumption of country spirit in these areas appears to be more ethnological than occupational. In other districts of these provinces the place of country spirits has been taken by other intoxicants such as *ganja* and opium. The only exception is Manbhum district where, with the development of coal mining industry, the use of liquor has also increased. The consumption is also somewhat higher in Monghyr where the people have a racial tendency towards drink, and where high cash wages are paid to the employees in railway workshops at Jamalpur.

*Pachwai* or *handia* is the universal drink of the aboriginal tribes such as Sonthals and Bhils inhabiting Chota Nagpur hills which comprise the district of Ranchi, Hazaribagh and parts of Sonthal Parganas. The total number of licences issued during the year for retail sale was 445, and the total number of home-brewing licences was 2,659. These licences were issued in the districts of Champaran, Bhagalpore and Purnea. *Tari* is largely used in Gaya, Monghyr, Saran, Muzaffarpur and Darbhanga, and is obtained from coconut and other palm trees.

3. *Orissa*.—In this province the general picture of addiction to alcoholic drugs is almost identical with that of Behar. The consumption of country spirit during the year 1936-37 amounted to 109,562.2 proof gallons, roughly 17 gallons per 1,000 of the population. The highest consumption is in parts of the agency tracts in Balliguda, G. Udayagire and Khondmals in Ganjam district.

*Tari* is the sap of the palm tree, and is used either freshly drawn from the tree or after fermentation. The date is the only variety of palm tree from which *tari* is drawn in this province. Last year 3,054 trees were tapped.

*Pachwai*.—Liquor brewed from *pachwai* with the help of a fermenting agent known as *bakkar ranu* is used in certain parts of this province. The drink goes by various names—*pachwai*, *handia*, *henda*, *paingan* and *sooram*. This is the favourite beverage of aboriginals. The retail shops numbering 60 for *pachwai* are mostly situated in Balasore and Sambalpur districts. Besides there were 846 licences issued for home-brewing. The chief consumers are Bhuinyas, Kols, and Santals. Special licences for manufacture of *pachwai* on festive occasions are issued to these tribes.

4. *United Provinces*.—The total consumption of country spirit during 1938-39 amounted to 327,925 proof gallons which works out to 7.1 proof gallons per 1,000 of the population. The factors influencing the consumption of alcohol in the United Provinces constitute (a) the larger number of towns in this province compared with others, and (b) the low percentage (14 per cent) of Mohammedans. The actual consumption of liquor is believed to be higher than that indicated by the excise returns. This is due to the fact that a large amount of illicitly manufactured liquor is used by the cultivators—a thing it is difficult to prevent. As already

pointed out, the area of highest consumption of spirits in this province adjoins Behar, areas between the Ganges and the Jamuna rivers, and in the north up to Lucknow. Most of the consumption of the country spirit is confined to the large cities and cantonments—Allahabad, Bareilly, Cawnpore, Gorakhpore, Mirzapore, Lucknow and Faizabad.

In the province both plain and spiced country spirits are used. The chief bases used for the manufacture of country spirit are *mahua* flowers and molasses. The admixture of these in varying proportions is also employed. The eastern districts prefer spirit manufactured from *mahua* or a mixture of *mahua* and molasses, but the western districts generally prefer spirit distilled from pure molasses. The Tharus of Gonda and Bahraich districts and the Bhutias of Kumaun use gram as a base for the production of spirit, while the inhabitants of certain parts of Naini Tal district manufacture *pachwai* or rice beer.

*Special exemption from the excise laws and rules in certain localities*.—The Bhutias are exempted, while residing within the parganas of Dharma and Johar and at the Bholia Parao at Dharchula in the pargana of Askot in the Almora district and in pargana Painkhanda in the Garhwal district of the Kumaun division, from all those provisions of the United Provinces Excise Act (IV of 1910), which prohibit the manufacture of liquor exempt under a licence and the possession of liquor in excess of retail quantities, provided that any liquor which they manufacture or possess is used for domestic consumption only and not for sale. The inhabitants of Jaunsar Bawar in the Dehra Dun district, which lies outside the town of the Kalsi and Chakrata cantonment, are exempt from the provisions of the Act, in so far as they are permitted to manufacture spirituous and fermented liquors, known as *sur* and *rabra* respectively, without any licence.

*Other country fermented liquors*.—*Sendhi*, a kindred drink to *tari*, made from the sap of the wild date palm *Phoenix sylvestris*, is also sometimes used. *Darbakra* is a variety of country beer obtained by fermentation of various herbs. This very slightly alcoholic beverage is used to a limited extent in the Azamgarh district. *Buza* is a fermented liquor made from rice and is very little used now. In the western districts of the United Provinces hemp preparations and opium are commonly used in place of country beers.

5. *The Punjab*.—The common country spirit used in the Punjab is prepared by the addition of flavours and spices to plain spirits, care being taken, for excise purposes, that the product does not resemble any foreign spirit. Plain spirits are also used and are distilled from cane sugar.

In 1939, the issues of spiced country spirit for consumption in the Punjab amounted to 317,156 gallons as against 82,758 gallons of plain spirit. The total consumption of both varieties amounted to 399,914 gallons. The consumption of spiced country spirit is encouraged because its use creates a demand for a drink which the illicit distillers are unable to supply. In the Punjab the proportion of urban population to the rural population is almost the same as in the United Provinces, with the difference that there are about 53 per cent Mohammedans in this province. Therefore the highest consumption is confined to definite areas comprising mainly the central districts of Lahore, Amritsar, Ferozepur, Jullundur, and Ludhiana, which are largely populated by Sikhs. Besides the above areas the consumption is also fairly high in the towns and cantonments of Simla, Ambala and Rawalpindi. In the northern and western districts, which are mostly populated by Mohammedans, and in the southern and eastern parts which are predominantly Hindu, the consumption of country spirit is comparatively low.

The country beers are used only in scattered areas of the Himalayas. The varieties known as *sur* and *lugri* and *chang* are the favourite drinks in the hill

tracts of the Kangra district, and in the parts of western Himalayas extending from Kashmir in the north and to Lahoul, Spiti and Kangar. Home-brewing of these beers is allowed in certain areas under licence. No *tari* is used in this province.

6. *North-West Frontier Province*.—In this province over 90 per cent of the people are Mohammedans, who have a strong feeling against the use of alcohol, and the population is for the most part rural. The consumption of liquor, therefore, is much lower in this province than perhaps in any other part of India. The total consumption of country spirit during the year 1939-40 was 10,114 L.P. gallons, and is confined mainly to the large towns. The habit of drinking exists only amongst the working and middle classes in the towns. The present rise in consumption can be attributed to the contact with other provinces, and mainly to the large military population. No country beer or *tari* is used in this province.

7. *The Madras Presidency*.—Arrack is the name given to distilled spirit used in this presidency. In South Kanara district, spirits distilled from cashew are very popular. During the year 1938 the total consumption of country spirits amounted to 999,685 proof gallons, which works out to be 22.6 proof gallons per 1,000 of the population. In this presidency the Mohammedan population is only 6.4 per cent, and for this reason the consumption of alcohol is comparatively high. The agricultural classes consume a large amount of toddy. The Madras and Bellary cities and the cantonment areas also showed a high consumption; the other districts with a high consumption were Vizagapatam and South Arcot. Sweet toddy is used in certain agency tracts in East Godavari, West Godavari and part of Guntur and Nellore districts. Fermented *tari* and Malabar *arrack* (spirit distilled from *tari*) are used in South Kanara. In this presidency *tari* is drawn from the coconut, sago, palmyra or date palms and *dadasal* trees.

In most of the areas the use of fermented country beers has been replaced by *tari*. The country fermented beers, such as *londa handa* and *sonti saru*, are sometimes used by the fishermen on the coast. The grant of licences for its sale was stopped in 1897-98, because of the availability of a more wholesome fermented liquor *toddy* or *tari*. In the southern districts a drink known as *akki bhoja* is largely used, particularly in Mysore plateau in Miland. The brewing and consumption of liquors is subject to little or no control in the non-regulated tracts of the Madras Presidency.

8. *The Bombay Presidency*.—The total consumption of country spirit during the year 1937-38 amounted to 1,054,518 proof gallons. The Bombay Presidency used to consume approximately one-third of the total liquors drunk in India. The consumption in this province before the enforcement of prohibition used to be nearly five times as much as in any other province of India. With regard to the consumption of liquor it is convenient to divide the province into the following three zones :—

I. *First zone* consists of Bombay town, and its suburbs—Kolaba, Thana Surat, Khandesh

and Broach districts—which form more or less a continuous tract of land. This area records the highest consumption.

II. *Second zone* comprises the towns of Ahmedabad, Nasik, Belgaon, Satara, Sholapur, Dharwar and Hubli which are all industrial centres.

III. *Third zone* comprises south coast districts of Kanara and Ratnagiri. The backward districts of Panchmahal and Kaira also show high consumption.

The high consumption in the first zone may be due to the following factors :—

(i) The natural inclination of the people for drink; (ii) the large fluctuating population in these areas; (iii) the damp and unhealthy climate; (iv) the better economic conditions, such as high cash wages earned by the mill hands in the mill areas and by the labourers and the fishermen in the sea, and (v) general prosperity and high standard of living. In Khandesh practically the whole population, except Brahmins, Wanis and Guzar-kumbis, indulge in the use of liquor.

The high consumption in the towns and industrial areas is due to the large proportion of the labour population belonging to races amongst whom drinking is common, and it may also be partly due to the nature of their work which necessitates the use of stimulants.

In the south-coast areas the high consumption is attributed to the damp and unhealthy climate, the natural inclination of the inhabitants of these areas to drink, and partly also to the better economic conditions of the people.

Toddy, both fresh and fermented, is used throughout the presidency. There are three kinds of licences, viz, shop licences, tree-foot booth licences and licences for domestic consumption. The domestic licences are issued mostly in certain *talukas* of Surat, Panchmahal and Poona and Kaira districts. *Tari* consumption is very high in Surat, Thana and Ratnagiri districts and in the town and island of Bombay.

In Panchmahal and Kaira districts the chief consumers are Bhils and other aboriginal tribes who indulge in illicit distillation.

9. *Sindh*.—Seventy-six per cent of the population of Sindh is Mohammedan. The well-to-do Sindhis are addicted to various sorts of spiced-liquor, drinking of the plain or cheaper liquors being left for the poorer classes. There is a fairly large industrial and drinking population in the city of Karachi. The total consumption during the year 1937-38 amounted to 109,399 proof gallons. Consumption is large in the towns of Karachi, Hyderabad, Kotri, Shikarpur, Sukkur and Rori. Toddy is sold only in the towns of Karachi and its suburbs, Hyderabad, Sakhar and Dadu districts. The total consumption during the year 1937-38 amounted to 42,682 gallons. *Tari* is used in Karachi district.

10. *Central Provinces and Berar*.—The total consumption of country spirits during the year 1939 amounted to 512,757 proof gallons. The population of the Central Provinces is mostly aboriginal in the hilly districts and agricultural in the districts to the north and south of Satpura range. It is partly agricultural and partly industrial in the cotton-growing areas, such as Nagpur, Akila and Amraoti districts. These factors determine the consumption of

liquors in these areas. The highest consumption of alcohol is recorded in Bhandara, a rich district at the foot of the hills. Chanda, Ellichpur and Mandla are largely inhabited by aboriginal tribes who consume country beers. In Chatthisgarh division, the consumption is lower in Raipore and Bilaspur, which are inhabited by Satnami Chamars. The local liquor made by simple fermentation from the sap of palm trees is also subject to taxation. The consumption of this liquor is confined almost entirely to the Nagpur, Bhandara, Chanda, Wardha, Jubbulpore, and Chhindwara districts.

*Toddy*.—Total consumption of *toddy* during the year 1939 amounted to 490,165 gallons; it is used all over the provinces. Tree-tapping licences are granted to Madia Gonds of Chanda district and also to certain other classes in Wardha, Akola, Saugor and Yeotmal districts, Hoshangabad, Nimar and Saugor districts.

11. *Coorg*.—The population of Coorg appears to be largely addicted to the daily use of alcohol, many of them earn daily wages. There is also a certain amount of consumption of *toddy*. The consumption of country spirit in 1938 amounted to 9,963.2 proof gallons with an incidence of 151.4 gallons per 1,000 of the population, the highest in India.

*Toddy*.—Unfermented *toddy* in this province is not subject to any taxation. Fermented *toddy* is used all over the province and there were 47 licences issued during the year 1940.

12. *Ajmer Merwara*.—The rate of consumption here is higher than in any other province except Coorg. Consumption of country spirit during the year 1938 was 61,461 proof gallons with an incidence of 103.3 gallons per 1,000 of the population. This appears to be largely due to (1) the presence of extensive railway workshops of the B. B. and C. I. Ry., and (2) on account of its being a popular place of pilgrimage.

13. *Baluchistan*.—The consumption of country spirit during the year 1938 in the Agency was 20,756.2 proof gallons, confined to Quetta and to a few other stations and villages mostly along the railway lines. The population is mostly Mohammedans who do not take alcohol.

14. *Assam*.—The consumption of country liquors amounted to 312,796 proof gallons during the year 1940. The low price of molasses, owing to the development of the sugar industry and cheapness of rice, has given impetus to illicit distillation, which is carried on mostly by the Nepalese tea garden coolies who are well versed in this art. Country spirit is used chiefly in towns. Recently the consumption has gone up on account of opium prohibition. In Assam, the consumption of beverages such as *zu*, *madh*, and *laopani* is universal and these are the main beverages of the aboriginal hill tribes. They have also been adopted by some of the lower Indian working classes, such as the tea garden coolies. Consumption of these beers is almost universal and extends along the border of the Himalayas right up to the Shan States in Burma. Little control appears to be exercised over their production in these areas. Further east, *marua* is used in Sikkim and the neighbouring hills, *zu* is the popular drink with the Nagas.

Some of these tribes never drink water, but always take beers.

*Tari* is consumed in Goalpara, Kamrup, Nowgong and Lakhimpur districts. The consumption of *tari* affects the sale of country spirit to a certain extent during the *tari* season in these areas. The tapping of *tari* and its sale, in an unfermented state, is exempt from all excise restrictions. It is reported that this privilege is being abused in many places.

For the convenience of the indigenous population and the aboriginal tribes residing in the province, free home-brewing of *pachwai* for home consumption is allowed up to a prescribed limit, and permits, free of charge, for brewing of *pachwai* on ceremonial occasions, in excess of the prescribed limits, are issued to such persons, on request. Such permits are, however, not required by the aboriginal tribes living in the hills and Frontier tracts, provided they act up to such instructions as the Deputy Commissioner or the Political Officer concerned may issue at his discretion. The total number of such permits issued during the year 1939-40 was 303 against 159 in the preceding year. As a result of the low economic condition of the people in general, and the low earning capacity of tea garden coolies in particular, the above privileges are much abused in almost all the districts. The consumption of *pachwai* affects the sale of country spirit to a considerable extent, more particularly in the tea districts.

#### CAUSES AFFECTING CONSUMPTION OF ALCOHOLIC DRINKS

##### A. Predisposing causes

I. *Ethnological factors*.—The question of race is a very important factor. To quote the majority conclusions of the Research Committee appointed by the Society for the Study of Inebriety, races that have long been exposed to the action of alcohol have grown more and more temperate. For example, Greeks, Italians, people of Southern France, Spaniards, Portuguese and the Jews, who have been most exposed to the action of alcohol, have grown more temperate. The nations of Northern Europe, on the other hand, who have been comparatively less exposed to the action of alcohol, for example the British, the Scandinavians and the Russians, are more prone to drink; whereas most uncivilized races, such as the Esquimos, the Red Indians, the aboriginal inhabitants of Australia and others who have had little or no racial experience of alcohol, are more prone to excessive drinking. Some of these races have been wiped out by the excessive use of alcoholic drinks. West Africans are an exception to this rule; they are comparatively temperate, but they consume a lot of palm wine. This rule also holds good in India. In this country the habit of drinking and drunkenness is much commoner amongst the aboriginal races, when an opportunity is offered to them, than amongst those that are more cultured. The Aryans and the white races, who introduced the use of alcohol from their original home in Central Asia, have grown more temperate, while the races such as the Sonthals, Bhils, Gonds, Nagas and other hill tribes belonging to the aboriginal stock, who have been less exposed to the use of alcohol, are more prone to excesses, when an opportunity is offered. It was observed that these races, although they are ordinarily given

to the use of country beers, always drink to excess if they can get stronger distilled liquors. Drunkenness is always common when economic conditions allow primitive peoples to buy stronger alcoholic drinks. Fortunately, this is not often the case, their means usually not allowing them to go beyond the cheap beers.

II. *Climatic factor*.—Taking the influence of climate, and treating India as a whole, it has been observed that the consumption of fermented and weak distilled liquors generally prevails in areas of heavy rainfall, e.g., in the mountainous and sub-mountainous tracts of the Himalayas, Chota Nagpur and along the Western Ghats. Weak alcoholic beverages, such as country beers, are commonly believed to be a necessity of life for dwellers in malarious tracts. In drier climates, such as those of the Punjab, Sindh and the United Provinces and parts of Bengal and Bombay Presidencies, where greater extremes of heat and cold prevail, strong spirits are more commonly used.

III. *Religious and social factors*.—Religious and caste factors also determine to a large extent the use of liquor in this country. The use of alcoholic drinks is prohibited among Mohammedans and certain classes of Hindus, such as Jains and Vaishnavites, and prohibition is strictly observed by the two last named. Generally speaking, among the upper and middle strata of society of India, drinking is uncommon except in moderation; this is especially the case among those who take to European habits and customs, such as the Mohammedans and most of the high caste Hindus. In the Tantric sect of 'Saktas', on the other hand, drinking is not only permissible but is even enjoined both for personal use and worship. A similar practice prevails among many of the most backward castes, notably on the east coast of Madras and in the forest tracts between Chota Nagpur and Godaveri. Amongst the dhubis of the Punjab and the United Provinces, an offender is required, as a caste punishment, to provide drink for the *panchayet* of the caste. This custom also prevails in certain other parts of India among the lower working classes, such as Chamars, on religious grounds. Recently there have been big demonstrations in Bombay over prohibition brought in by the Congress Government of that province and also by the Parsees, for similar reasons. The use of *pachwai* is considered necessary at religious and social festivals by Sonthals, Garros, Koeh, Dhangars, Mandais, Tipperas and other aboriginal tribes. The Sonthals, especially the women, object to the use of *pachwai* that is bought from a shop.

There is a general belief amongst the hill tribes that fermented liquors are less injurious than distilled spirits. The use of these fermented liquors is not only permitted but it is encouraged by custom. On the occasions of religious worship, among many of the backward races inhabiting the Western Ghats and in the

hilly tracts between Chota Nagpur and Godaveri, the use of these liquors is considered essential. Men, women, and children all indulge, there being no restriction as to caste or creed. Among the Sonthals and Bhumji tribes of Chota Nagpur, fermented liquors are considered to be indispensable at funerals, marriages and other ceremonial occasions. Mohammedans are forbidden by their religion to take alcohol, and for that reason in the Western Himalayas, where the population is predominantly Mohammedan, these liquors are not much used.

IV. *Occupation*.—This is perhaps a more important factor than caste and religion in influencing the consumption of alcoholic drinks. A departure from the pursuit of agriculture has commonly the effect of weakening the traditional restrictions against indulgence in alcohol, an effect which is enhanced by the difficulty of maintaining the old customs under the more complex town life. The conditions of employment in Indian factories and industries, such as jute, cotton, coal and mining, cause the workers to feel the need of a stimulant after the day's work is done, and the high wages enable them to satisfy this desire. The mill hands in Calcutta, Bombay and other industrial towns, such as Cawnpore, are a good example. It is for this reason that about a dozen of the large cities in India with the bulk of the industrial population consume approximately one-fourth of the total alcoholic drinks consumed in India.

There are other factors, such as the presence of a floating population at the time of certain fairs or gatherings, which lead to a heavy consumption of alcohol. We have observed that during festivals the consumption goes up by 40 to 80 per cent in certain localities.

V. *Belief in medicinal value*.—When a relative or friend is feeling 'out of sorts' or 'seedy', a man habituated to liquor often suggests a dose as a prophylactic or curative. There is a belief amongst certain sections of population in this country that the use of alcoholic beverages is a necessity as it keeps out damp and cold, and is a prophylactic against malaria, cough and colds.

VI. *As source of vitamins and digestive adjuncts*.—Beers generally are regarded as stimulating, refreshing and thirst-quenching beverages that have a definite food value. According to analysis done in our laboratory, most of them contained 1.4 gm. of sugar and 0.6 gm. albuminoids per 100 c.cm.; there is no doubt therefore regarding their food value. In fact they have the combined value of a food and a stimulant. The quantities of carbon dioxide and other substances present may even promote digestion by stimulating various digestive juices, and thus they may act as adjuncts in facilitating the digestion of other foods. They also supply quantities of salts of potassium and sodium, calcium phosphate, etc., which are among the more important of minerals required for the

repair of the tissues after the wear and tear of hard physical exertion.

It is well known that plants of all kinds, including lower forms of vegetable growth, contain water-soluble substances which promote growth and nutrition. Brewer's yeast is a recognized source of vitamin. The crude beers which contain both moulds and yeasts should therefore form very rich sources of water-soluble vitamins belonging to the groups B<sub>1</sub> and B<sub>2</sub>, and probably also vitamin C. Most of the people who habitually take country beer are very poor, and cannot always secure for themselves a varied diet containing all the principles required for proper nutrition. Our inquiries have convinced us that the majority of such tribes are subsisting on a poor, restricted and sometimes unbalanced diet of a monotonous character. It is remarkable, however, that these primitive people are particularly free from any of the deficiency diseases which have wrought havoc in some parts of the world. The beers have been shown to be rich sources of vitamins and it is not unlikely that the supply of vitamins through their agency is responsible for the absence of deficiency diseases in these communities. Yeasts, which also occur in these beers, also contain hæmatopoietic principles, and they have been used successfully in the treatment of anæmia.

VII. As food.—Most of the common alcoholic beverages used in India have a considerable food value. During the process of fermentation many undigestible carbohydrates are converted into more readily assimilable sugars. The nutritive value of rice beers, such as *pachwai* and *zu*, is undoubtedly substantial. The Nagas never drink milk or use milk as a food; they always drink *zu* prepared in their own homes. In the mountainous regions of India where economic conditions are poor and the natural craving for a stimulant is greater, on account of climatic conditions, the use of country beers and spirits, offered at prices commensurate with the means of the people, has been in vogue from very early times. These mild drinks are to the poor what the different varieties of expensive alcoholic liquors are to the well-to-do.

VIII. As a euphoric.—For the most part people resort to alcoholic drinks in order to tide over the feeling of exhaustion after a day's hard labour in the fields, in the tea gardens or during the trying winter season. *Pachwai* is used by practically all the male and female workers in the coal mine areas of Bengal and Bihar, and is usually indulged in after the day's labour is done. The work is so hard, uninteresting and monotonous that it would be difficult for them to get through it every day without their beer. The quantities taken are often moderate, just sufficient to relieve the feeling of fatigue and ensure sound sleep. The prospect of getting it is often an incentive for work.

IX. Economic conditions.—All circumstances which affect the prosperity of the people in

general have a direct influence on the consumption of alcohol. Consumption rises in good years and falls in bad years; it falls to the minimum during famine years. The present authors observed that the consumption rises after the harvest season in the Punjab, when people have plenty to eat. Furthermore, consumption in the shops in the mill areas rises higher on pay days than on other work days.

X. Epidemics.—Outbreaks of epidemics, such as cholera and plague may also be accompanied by a large increase in the consumption of liquors owing to the people taking liquor, partly in the belief that it is a prophylactic and partly to overcome the fear of the disease. This tendency was clearly observed in the last great plague epidemic in the Punjab during 1902, and it has been observed in other epidemics since.

XI. Relation to other intoxicants.—It is of interest to discuss here the comparative consumption of other forms of intoxicants used in India along with alcohol and how their consumption affects that of liquor. An attempt has been made to compare the consumption *per annum*, in different provinces, of spirits, country beers, opium, *bhanga*, *ganja*, and *charas*. The popularity of alcoholic beverages in the same area may vary from time to time according to the fluctuations in prices of different intoxicants. The people sometimes take to toddy instead of spirit when the prices of spirits are high. This is a common occurrence in South Kanara, Surat and Konkan districts in the south.

A very remarkable instance of change of stimulants, following the increase of taxation, is that of people resorting to country beers in Bombay and Madras Presidencies where the taxation in distilled spirits has been raised to a high level.

#### B. Exciting causes

Ease of access to alcoholic beverages must be considered as an important causative factor in leading to their regular use. It has been found that the drinking habit is easily picked up and is quite common amongst the aboriginal tribes and in families where some other members of the family take alcohol. The use of alcohol is universal amongst the tribes who are allowed to manufacture their own drinks or who have easy access to it.

The important precipitating or immediate causes of habitual use of alcohol are related to the previous uses of such beverages in medical treatment, to self-treatment for the relief of pain, to recourse to drugs during emotional stress. In an investigation carried out by the present authors, over 50 per cent of the habitués attributed their addiction to contact or association with other habitués, to a desire for experience, to satisfy curiosity, to obtain a thrill, or to their use during emotional distress.

(Concluded on next page)



## MEASUREMENT OF RADIANT ENERGY IN LIGHT THERAPY

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*Director, Solarium, Jamnagar*

### *Necessity of measurements*

MEASUREMENTS are necessary to the progress of any science or art; its understanding and advance greatly depend on the refinement and organization of its measuring agents. Simplicity of measuring devices is one of the important factors which make a science adaptable to practical use. In ray therapy the question of measurements presents one of its main difficulties.

This question is very much simplified in the case of chemical medications used in the current system of medicine. The drugs are visible and can be easily measured by the measure-glass and the balance, fairly accurately. The important part the measure-glass and balance play in medical practice is lost sight of, on account of their simple and common nature. But once take them away from the doctor's chest, then will their indispensability and importance become obvious.

In ray therapy this question still remains difficult and complicated, as it has to deal mostly with invisible agents which are not accurately known, whose production in uniform quality is not yet achieved and which undergo a number of changes during transmission.

Neither the sun, nor the artificial sources of light can be made to produce the required radiations in isolation. They produce them along with many other kinds of radiations. So we have to measure not only the quantity but also determine the quality of radiations emitted

*(Continued from previous page)*

The persons below 30 years all attributed their addiction to contact and association with other habitués. Ten per cent of cases attributed it to the previous use of drugs in medical treatment and to self-administration for the relief of pain.

The underlying causes of habitual use of alcohol are related to the inherent constitutional make-up of the individual. Individuals with unstable nervous systems are more prone to the habitual use of alcohol and other drug habits than those with a stable constitution. This is one way of saying that those with mild psychic disorders or those with a variable proportion of mental aberration are more prone to alcoholic excess. An approach to the partial solution of narcotic drug addiction must therefore take into account the mental and hygienic factors involved. In a series, which was accessible to us for study and observation, more than one-fourth attributed their addiction to the previous use of these drugs in medical treatment or to self-treatment for the relief of pain. The others began at the instance or company of a friend or associate.

(Part III will appear in our next issue)

by them. Radiations undergo so many changes during transmission that it becomes necessary to measure them at the site of absorption instead of at the site of emission to ensure accuracy.

Accurate measurement of such variable and indefinite agents is impossible to achieve until we know them perfectly, and until we have handy unerring instruments to measure them. We cannot, however, wait till then. We must make our way with whatever implements we have.

The highly technical instruments in use in research laboratories which are capable of taking very minute measurements are unsuitable for ray clinics. But there are simpler instruments, which though not so fool-proof as the clinical thermometer can still be recommended for fairly accurate and reliable results. We will describe the various instruments used for measurements in ray therapy.

### *Qualitative measurement*

*Spectroscope and spectrograph.*—The spectroscope and spectrograph provide perfect instruments for accurate qualitative determination. By their means their wave-lengths as well as their intensities can be determined. The wave-lengths are measured in metric units either of Angstrom or micron. The spectrograph is the most essential instrument for the study of radiations.

In the spectroscope (figure 1) there is an arrangement to receive the light for detection.

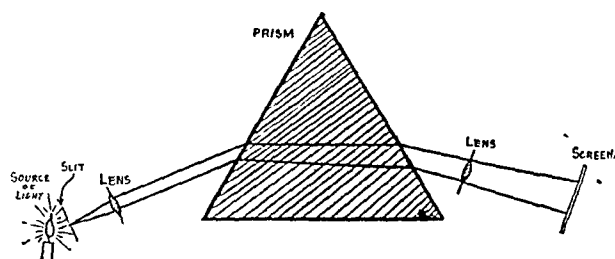


Fig. 1.—Principle of spectrographs.

It is concentrated by means of a lens on the prism where it is dispersed into its components. These are again focused on a fluorescent screen by a focusing or telescopic lens inserted between the prism and the screen. If the spectrum is to be photographed the camera should be inserted in place of the screen. This is a spectrograph.

Another device used in the spectroscope is the diffraction gratings ruled on a reflecting surface of speculum metal. Gratings ruled on a concave spherical surface will give a clear spectrum. This type of spectroscope is specially useful in the study of shorter wave-lengths (under 1,500A).

The spectroscope measures the quality of radiations present and the intensity of each wave-length. In knowing the value of any source of light the photo of spectral lines is not the complete guide, but it should be accompanied by the table or chart showing the relative intensity of each wave-length.

*Quantitative measurement*

There is no direct method for quantitative measurement of radiations, so indirect methods have to be devised. The radiant energy is converted into other forms of energies which are measurable, or is made to cause chemical or biological reactions which can be measured.

The radiations to be measured are directed on the receptor which is capable of absorbing them. Liberated radiant energy is transformed into an appreciable and measurable action. As conversion takes place into various other forms of energy, it will be useful to have a table of equivalents of various energy units here.

reaction as the measure of efficiency of ultra-violet generations.

2. Erythema reaction is adopted as the main guide to ascertain the sensitiveness of the patient's skin to decide the dose.

(b) *Lethal action*.—1. *Killing of protozoa*. Infusoria killing unit is fixed. The intensity of rays is measured by the time they take to kill the standard unit of infusoria culture.

2. *Germicidal power*.—In this standard culture of bacteria is used (Jausion).

This method is made use of in commercial ultra-violet sterilization.

*Table of units*

| Name of the unit          | Definition   | Equivalent in other units   |
|---------------------------|--|---|
| Angstrom ..               | Unit of wave-length  | $\frac{1}{10} \text{ m}\mu = \frac{1}{10,000} \mu = \frac{1}{10,000,000} \text{ mm.}$ |
| Erg .. ..                 | Unit for work  | $\frac{1}{98,100,000}$ —kilogramme meter.<br>10,000,000 ergs.                         |
| Watt .. ..                | Unit of electromotive force or the force sufficient to cause a current of 1 ampere to flow against a resistance of 1 ohm.  | $\frac{1}{1,000,000}$ watts = 10 ergs.  |
| Micro-watt ..             | A millionth division of a watt   |   |
| Calorie .. ..             | Unit of heat therapy. The amount of energy which could raise the temperature of 1 kilogramme of water from 0° to 1°C.  | 697,000 ergs.   |
| Calorie gm. minute ..     | Same heat given in one minute  | 697 ergs or 69 micro-watts.   |
| Milli. calorie gm. minute | Unit for the measure of the ABC divisions of the U-V rays.   |   |
| Finsen .. ..              | Unit for the measurement of U-V rays provoking erythema equivalent to the erythema effect on 1 cm. <sup>2</sup> of 6,000 ergs transported by radiation with wave-length of 2,967Å.     |   |
| Abion .. ..               | Bactericide power of U-V rays killing 1 million staphylococci contained in 1 cm. <sup>3</sup> of water with 7 per cent sodium chloride and exposed for 100 seconds at 10 cm. distance. |   |

Ergs, watts, and gm. calories are the units of measurement of energy.

If the receptor is a chemical substance, the change or colour or formation of precipitate would enable us to estimate the intensity of radiations.

In biological methods, cultures of microbes or protozoa are exposed to the radiation. The killing effects on the microbes and spores are compared to the fixed standard. For erythema human skin is exposed to ultra-violet radiation. These biological reactions depend upon individual factors.

The following methods based on physical, chemical or biological reactions are in common use for the measurement of the intensity of radiations possessing those properties :—

*I. Biological reactions*

(a) *Erythema reaction on human skin (wave-length 2,400–3,100Å)*.—1. The Council of Physical Therapy in America has adopted this

*II. Fluorescence and phosphorescence*

These properties of certain wave-lengths are made use of to detect their presence and sometimes to measure their intensity.

*III. Thermal effects*

When any radiation is absorbed in a body, the radiant energy is converted into thermal energy in the body. If there were a perfectly black body, it would completely absorb all wave-lengths of radiations. Consequent rises in temperature of the body would give us accurately the measure of total energy of radiations. Such a perfectly black body is not yet found, but a surface coated with lamp-black or platinum-black answers the requirement for all practical purposes.

The construction of the principal measuring apparatuses, viz, bolometer, thermopile and micro-radiometer, is based on the transformation of radiant energy into heat. The simplest means

for measurement of heat is the mercury thermometer. But, as mercurial changes in thermometer are affected by a number of other factors, the thermometer cannot be regarded as a very accurate means of measurement in case of radiant energy.

The thermocouple makes use of Seeback's discovery that, when two conductors with varying temperatures are joined to form a circuit, a direct continuous electric current flows in the circuit as long as the difference in temperature is maintained. In it two metals with varying conductivity are used to make a junction so that the same heat produces unequal temperature in them. The thermocouple is covered with lamp-black and platinum-black which absorb almost all radiations and convert them into heat energy. It is connected with a delicate galvanometer which registers the electric current which is in proportion to the heat produced in the metal pieces on absorption of radiations falling on them.

A thermopile consists of a number of thermocouples connected in series. The multiple junctions of thermo-elements make it an instrument of considerable accuracy for radiometric work. By careful construction its sensitivity may equal that of the bolometer and it has the advantage of being more handy than the bolometer. These instruments do not deteriorate or go out of order easily and hence they are mostly used in radiotherapy.

The bolometer measures this heat by the increased electrical resistance of strips of metal coated with platinum-black which are placed in an electric circuit. The resistance is measured by a galvanometer attached to the instrument. By a bolometer it is possible to measure difference in temperature so minute as one millionth of a degree. It is a very delicate instrument and therefore not of practical use in actinology.

In micro-radiometer the thermopile and galvanometer are combined in a single instrument. The instrument furnishes a very delicate means of measuring radiant energy.

#### *Photo-chemical actions*

Photo-chemical methods used to determine the intensity of radiations are of two types:—

1. Photographic method.
2. Other photo-chemical methods.

It is known that light causes many kinds of chemical reactions, such as oxidation, reduction, etc. Light can accelerate certain chemical reactions, and, owing to its selective action, light can cause many photo-chemical reactions in quite a specific manner.

Many types of actinometers are contrived on the basis of these properties of light to measure its intensity. Photography is the most developed method.

Changes in colour or transparency are the means of measurements in other methods. The results of these chemical methods are dependent upon a number of factors such as temperature,

pressure, concentration, purity of chemicals, etc. They cannot be considered so accurate as thermal or electric methods of measurement.

#### *Photo-electric effects*

Light is converted into electric energy under certain circumstances. Every substance has a critical or threshold wave-length, that is, when radiations of shorter wave-lengths than threshold wave-length fall upon it, it begins to emit electrons. Wave-lengths below 3,000Å generally produce these effects in most substances. There are some metals where these effects are produced by longer wave-lengths. The number of electrons given off is in direct proportion to the intensity of the radiations. This property is utilized to detect the presence and measure the intensity of ultra-violet radiation specially.

For practical purposes, only a few metals exhibit any appreciable useful sensitivity to light, and, since all tarnish in air, it is necessary to enclose them in a vacuum or inert gas in a glass cell. The current may be measured by ordinary instruments, such as the electrometer or electroscope or voltmeter; the current may be amplified before measurement. The instruments used are the photometer or photo-electric cell. These instruments are very delicate and deteriorate rapidly.

*Photo conductivity.*—In some substances the effect of light is to increase their conductivity. No new electric energy is produced but there is easier conduction of the same current. This property is specially marked in selenium. Selenium photo-electric cells are therefore used to measure the intensity of ultra-violet rays.

#### *Instruments used in the solarium*

We give below the brief description of the instruments we used in the solarium for the measurement of radiations—solar as well as those from artificial sources.

1. *Helio-actinometer* (figure 2).—The helio-actinometer for the measurement of solar radiations consists of a thermopile connected with a galvanometer. The thermopile consists of ten or nineteen junctions. The thin plates which are made of an alloy of nickel and alloy of constantan are 5 millimetres broad and 30 millimetres long. The extremities of these plates are fixed to a brass block or to the tubes forming radiators for dispensing the heat absorbed.

There is a groove in the brass block or between the tubes to receive the thermometer to measure the temperature. The latest model of 1940 has been improved so as to show the value of each junction separately also.

The area of thermopile exposed to the sun is 7 cm. by 2 cm., or 12 cm. by 2 cm. Each junction can carry one millivolt of current.

The galvanometer is also specially modified. There is direct movement of the needle and lowest possible resistance is arranged. The dial on which the needle moves shows one hundred

divisions the total value of which is approximately 1.5 gramme-calories.

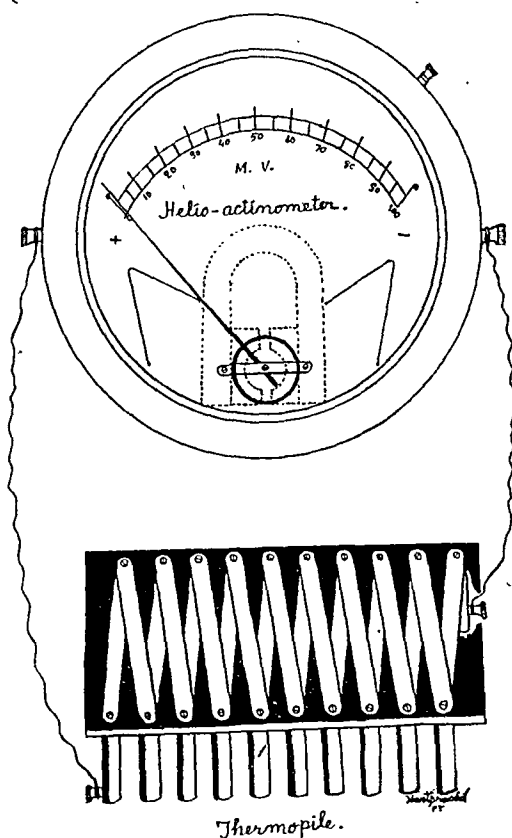


Fig. 2.—Helio-actinometer.

There are four such thermopiles used for the measurement of solar radiations:—

1. For measuring the intensity of total radiations.
2. For measuring the intensity of infra-red radiation. This thermopile is covered with a glass of selenium oxide which allows only the red and infra-red rays to fall on thermopile.
3. The pyrliometer. The thermopile is put in a cylinder ten inches high to prevent the diffused radiation from falling on the thermopile.
4. For measuring the intensity of the ultra-violet radiations, there is no filter which allows only ultra violet to pass. Even the best ultra-violet filters are transparent to some infra-red rays. So accurate measurement of ultra violet is not possible. To obviate this difficulty a contrivance is made by connecting two thermopiles in opposite directions. The first thermopile is covered with ultra-violet filter and an infra-red filter under it; and the second one is covered with ultra-violet filter alone. The first thermopile receives only infra-red rays while the second receives infra-red and ultra-violet rays. The current produced by infra red in both will be neutralized leaving the current produced by ultra violet to be measured by the galvanometer.

To avoid frequent calculation of the time of exposure due to the variations in the intensity

of solar radiations and thus to facilitate the accurate dosage, a special counter-helio-actinometer or totalizator (figure 3) is designed

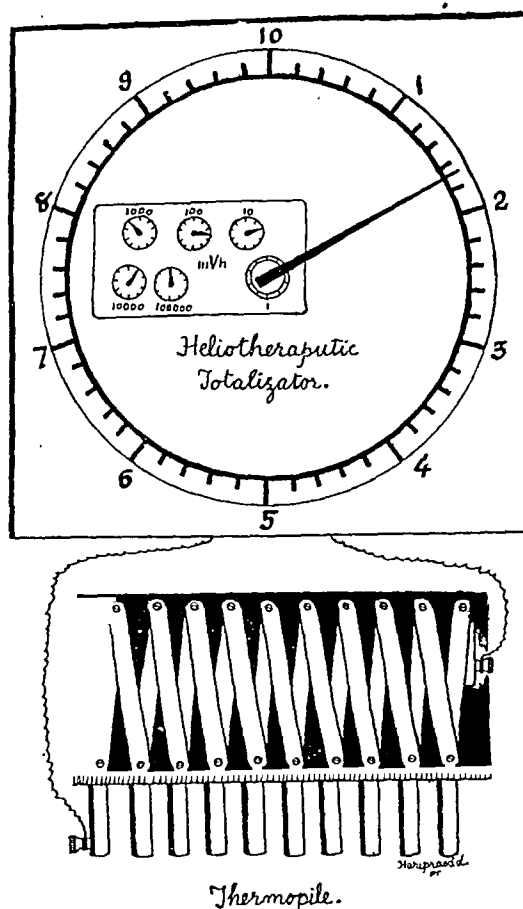


Fig. 3.—Counter-helio-actinometer.

whereby the exact intensity of solar radiation is automatically registered in solar units. This apparatus consists of a thermopile of 19 or 50 junctions to receive sufficient amount of solar energy to move a small rotator raised on a pivot and placed between the extremities of a powerful magnet. This works on the principle of electric motor. The revolutions of the motor are recorded on a dial with unit marks. The needle moves slowly or briskly according to the motion of the motor which depends on the intensity of radiation. One unit is equivalent to 2.5 gramme-calories.

II. *Spectrograph.*—There is a specially prepared spectrograph for continuously photographing the spectrum of ultra-violet constituent of sunlight.

The sunlight and diffused skylight are reflected on the slit of the spectrograph from a white plate of pure magnesium. This light is concentrated on the slit by means of a quartz lens and nickel oxide filter is inserted to remove visible radiations which would otherwise eclipse the spectrum of ultra violet. The spectrum is being continuously photographed from sunrise to sunset on a standard 35 mm., film roll turning on a rotating cylinder.

III. *Photo-electric cell* (figure 4).—Silver selenium alloy is used to produce the photo-electric effects which are shown on a very delicate galvanometer. As visible and ultra violet both produce photo-electric effects on silver selenium, a nickel oxide filter is used to cut off the visible rays.

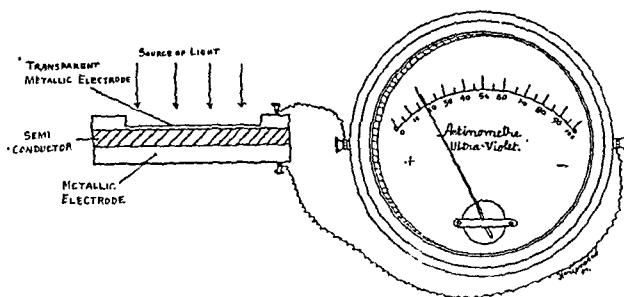


Fig. 4.—Photo-electric cell, with galvanometer.

IV. *Chemical actinometers*.—Two types of chemical actinometers are used in the solarium. One is meant to ascertain existence and amount of erythema producing wave-lengths in the emission of a particular source of light. A filter-paper soaked in a colourless solution of paraphenyldiamine is exposed to the light. The filter-paper will become greyish green and then dark grey in proportion to the quantity of erythema producing wave-lengths in the light. A disc of standard colour is kept for comparison.

Another actinometer is called the leucobase. This consists of a short quartz tube which contains an alcoholic solution of leuco-cyanure triphenylmethane which is normally colourless. The reagent takes various grades of pink colour when exposed to ultra violet shorter than 3,150A according to the intensity of radiations. A colorimeter containing ten graded discs of colour is attached to the instrument of fixing the value of colour change in the quartz tube.

V. *Sunshine recorder* (figure 5).—It is an instrument to record the intensity of bright

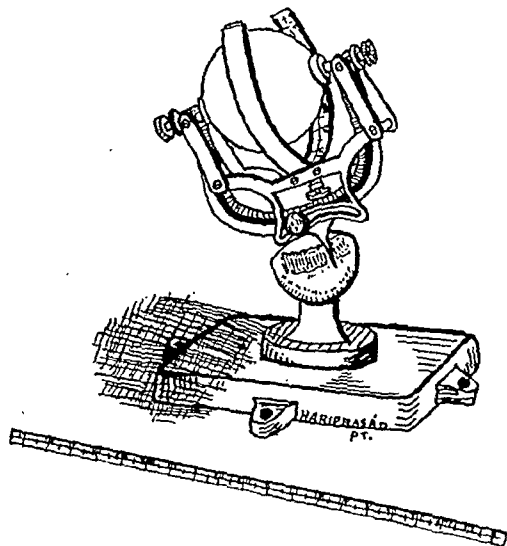


Fig. 5.—Sunshine recorder.

sunshine. Sun's rays are focused by means of a glass sphere upon specially prepared and printed cardboard strips. The frame carrying the chart must be tilted and clamped to the correct latitude of the place of observation. Various grades of charring occur on the strip according to the intensity of sunshine.

VI. *Konimeter* (figure 6).—Konimeter is an instrument for counting the number of dust

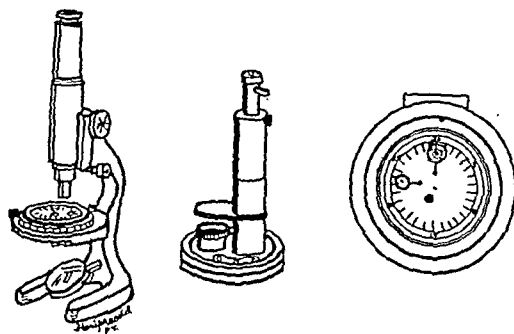


Fig. 6.—Konimeter.

particles in the atmosphere. A measured quantity of air is sucked by a pump through a jet passed through a circular glass plate mounted to rotate. The fine jet of air impinges perpendicularly upon the moistened plate and in so doing deposits there its dust contents. The arc of glass plate on which dust is deposited is put under the microscope and the number of dust particles counted. As dust particles play an important part in the diffusion of solar ultra-violet radiation, the counting of dust particles in the atmosphere is a useful procedure in a helio-observatory.

## Medical News

### ANTE-DATE OF COMMISSIONS

THE Government of India have decided that ante-date for professional experience, assessed on the basis of half the period between the date of medical qualification and the date of appointment, should be calculated to the nearest day subject to a maximum of five years and with no minimum.

Three months ago, the Government intimated the concession of ante-date based on professional experience to emergency commissioned officers of the Indian Medical Service. The ante-date, which is limited to five years, was to be reckoned by periods of six months on the basis of half the number of completed years from the date of medical qualification to the date of appointment to the Indian Medical Service and the minimum ante-date admissible was one year, earned by two years' medical practice.

### MEDICAL ASPECTS OF CIVIL DEFENCE

(INDIAN MEDICAL ASSOCIATION, BENGAL PROVINCIAL BRANCH)

Report of the Emergency Medical Service Standing Committee of the Indian Medical Association

DUE to the present international situation, it seems India is most likely going to be the next theatre of war. To avoid mistakes committed owing to unforeseen circumstances in the Far East, the following suggestions are laid down for better safety of the people of

this province. As the State is involved in great crisis it is desirable that the Government on no account is to be embarrassed, but it should receive adequate co-operation from the members of the medical profession to render due medical aid to the public. With this view the attention of the Government and the public is drawn to the following skeleton scheme:—

1. Planning regarding dispersal of population from congested and vulnerable areas.

As the question of air-raid attacks on Bengal is at the present moment a practical possibility, the Bengal Provincial Branch of the Indian Medical Association is of the opinion that to deal properly with the air-raid civil casualties, dispersal of certain types of population from the congested and vulnerable areas to comparatively safer zones should be arranged with a well-laid plan. The people should not be simply advised to evacuate from the so-called danger zones on a voluntary basis without a definite plan regarding the medical and other arrangements for their reception in selected areas. The Government of Bengal should render proper facilities for voluntary evacuation of the school children, expectant mothers, mothers with very young children, old and infirm persons and chronic invalids. Beggars, lepers, mental cases and the like must be evacuated, on a compulsory basis for preservation of morale and establishment of confidence amongst people staying back in the vulnerable areas.

For purposes of 'planned evacuation', therefore, the province of Bengal should be divided into three groups of regions in the same lines as those issued by the Ministry of Health in England in a Schedule dated the 9th January, 1939:—

1. A limited number of large crowded areas from which evacuation is to take place.

2. A number of 'neutral' areas mainly situated in and around the towns which are not to be evacuated but are also not to be used for reception.

3. The areas considered most suitable for reception of the evacuees.

The next question that arises is that of providing the evacuees with food, protection, shelter, etc. The question of education of the evacuated children has also to be taken up by the Hon'ble Minister of Public Health who is now in charge of the 'Civil Defence' Department in collaboration with the Minister in charge of Education.

2. *Medical provisions for receptive areas.*—The evacuation of women, children, and others to safe areas has already thrown a great strain on the public health staff and the sanitary resources of many rural and urban regions. Moreover, the medical resources of most of our rural areas have already been declared both by the Government and the Indian Medical Association to be grossly inadequate for peace time. The Bengal Branch of the Indian Medical Association has already placed before the Government a comprehensive scheme for re-organization of rural medical and public health services. The Association is of the opinion that the present time is opportune for launching the scheme as an experimental measure especially in those rural areas which have become congested as a result of the dispersal of the population. The rural medical re-organization scheme will, of course, need some modifications to suit the present emergency conditions. A rural health unit with a qualified doctor, a health assistant, a trained *dai* and a servant with necessary medical and public health equipments should immediately be established in every Union Board now congested as a result of evacuation from the danger zones of Bengal and Burma. Modernized cottage hospitals with general and maternity beds and with the necessary medical equipments and personnel should also be established with the least possible delay in all affected thana centres and poorer municipal areas for medical relief and public health work there. The question of expansion of laboratory facilities and suitable arrangements regarding possible epidemic outbreaks, accommodation of infectious cases, water supply

and sewage disposal, etc., are also important items in the medical provisions for the receptive areas.

3. *Medical provision for civilian defence.*—Modern techniques of warfare leading to the possibility of unheralded bombing of civilian populations make imperative the preparation of facilities for providing medical service to casualties that may result from such incident. An organization for these emergency facilities must be a fundamental part of our civilian defence programme. With the advent of the war in England, the country had been divided into *regions* which could function independently if cut off from other areas by the destruction of communications by air attacks and a similar division of medical arrangements was also carried out at the same time.

The general aim was to provide in the danger areas for the collection, first-aid attention and sorting of casualties, and for enough treatment at the *Casualty-Clearing Hospitals* to fit them for a journey by ambulance. Next to provide *advanced base hospitals* in presumably safer areas fully equipped in both apparatus and personnel to carry out all necessary operative or other treatment of the injured; *base hospitals* still further from danger to which patients could be moved for after-treatment; and finally a group of less well-equipped *hospitals for convalescent* and chronic cases. London formed one region, but on account of its dense population and liability to attack it required special consideration. The Metropolitan Police district and the area within about forty miles was therefore divided into 10 *sectors* radiating out from the twelve big London teaching hospitals, which were to be the main casualty receiving hospitals for their sectors.

The Bengal Provincial Branch of the Indian Medical Association has carefully gone into this question and is of the opinion that medical arrangements similar to those adopted in England should immediately be provided in the different regions of the province. The question of administrative control is also of great importance. The first-aid parties, police, civic guards, fire and demolition parties, and the question of transport, etc., should be controlled by the Home Department. The Mobile First-Aid Units, First Aid Posts, Casualty-Clearing Hospitals, Advanced Base Hospitals and Base Hospitals should be administered under the Minister of Health. The Government have already made some arrangements regarding the first-aid parties and the first-aid posts. The question of transforming the existing hospitals in and around the city of Calcutta into Casualty-Clearing Hospitals is also under consideration of the Government. The Association expects that the arrangements made should be adequate and effective without any further delay. Up till now, the Government have not apparently evolved any scheme of establishing well-equipped Advanced Base Hospitals for the operative and other treatment of civil air-raid casualties; Base Hospitals for the after-treatment and hospital for treating convalescent and chronic cases. If 8,000 beds are considered necessary for the Casualty-Clearing Hospitals, at least 16,000 beds shall have to be arranged in the Base, Advanced Base and Convalescent Hospitals in accordance with the outlines of the scheme followed in Great Britain. On 7th September, 1939, the then Prime Minister said in the House of Commons that over 200,000 hospital beds were then ready for air-raid casualties in England and Wales and plans for new hospital units were under consideration. Out of these 200,000 beds, 56,500 were in the London region, 15,500 being inside the county and 41,000 outside. He also said that 'nearly 2,500 doctors had accepted enrolment in the emergency medical service and acceptances were being received daily'.

Considering the urgency and importance of the problem, suitable steps, in transforming some of the outlying teaching hospitals (e.g., in Burdwan, Jalpaiguri and Bankura) into Base Hospitals and some of the suitable subdivisional and other hospitals (e.g., Midnapur, Krishnagar, Chinsura, etc.) into Advanced Base and Convalescent Hospitals, be immediately taken and necessary medical equipments and personnel be dispersed for working out the scheme.



**Medical education.**—As in England, pre-clinical teaching should be stopped in the danger zones and suitable arrangements be made for their teaching in safer areas. Regarding clinical teaching in hospitals, those needing elementary clinical instruction should be despatched to the base hospitals whereas the other students be divided amongst all the other hospitals. The amount of clinical material and the opportunities for practical experience will be enormously increased in the Advanced Base and Casualty-Clearing Hospitals and this should more than compensate for the dispersal of clinical teachers.

**Rôle of the Indian Medical Association.**—In Great Britain, the British Medical Association acting on behalf of the Government established a register of all men and women who would be available, and appointed a Central Emergency Committee (later the Central Medical War Committee) to keep the register up to date. Requests for additional personnel were to be made to the Ministry through the hospital officer, and the Committee was to advise on the appointment of doctors so that they could be distributed to the best advantage. Local medical war committees were appointed to deal with problems arising in their own districts. The members of these were elected by the practitioners of each district at meetings convened by the B.M.A., but open to all, whether members of the Association or not. The above extract (*Lancet*, 31st August, 1940, p. 279) clearly indicates the position of the B.M.A. in relation to the medical problems of the Civil Defence Scheme of the Government in the United Kingdom. The Bengal Provincial Branch of the Indian Medical Association draws the immediate attention of the Government and the public bodies to the above paragraph and requests the Government of Bengal to follow the example of the British Government in Great Britain in dealing with matters relating to their emergency medical services. The Bengal Branch of the I.M.A. will be too pleased to assist the Government of Bengal in working out the details of the medical aspects of their Civil Defence Scheme.

### SCHOOL MEDICAL SERVICES IN THE PROVINCES

The creation of school medical services in provinces and states is recommended by the joint committee appointed by the Central Advisory Board of Health and the Central Advisory Board of Education to investigate and report on the question of medical inspection of school children and the teaching of hygiene in schools.

In each major province, the committee says, there should be a whole-time chief school medical officer to administer the school medical services which should have a sufficient number of doctors for medical inspection and treatment of school children. The provincial governments should bear at least 50 per cent of the cost.

The scheme should include both primary and secondary schools and it should be a condition of recognition that each school takes part in the scheme. Medical inspection and treatment should be provided free for the children of all primary schools and of the primary departments of secondary schools. In secondary schools, particularly in urban areas, the fees charged should include a contribution towards the cost of medical inspection and treatment.

**Supplementary feeding.**—Probably 50 per cent of the children attending school, according to the committee, would be found to require medical attention or medical observation. It lays special emphasis on treatment and follow-up. A scheme for medical inspection without provision for treatment and follow-up, it says, is of little or no use. Schemes for treatment must include provision for supplementary feeding. All children should have a mid-day meal whether it is brought from their homes or provided at the school.

Other recommendations include the provision of school clinics particularly in urban areas, health and cleanliness parades before school starts and instruction to school children in personal hygiene.

**Requisites of a teacher.**—For teachers it is recommended that hygiene should be a compulsory subject in all courses for their training and practical demonstration should form an important part. Teachers should be taught by practice to recognize defects in children and to do elementary treatment.

The physical instructor of a school should have training in the elementary principles of physiology, of the hygienic mode of life and of nutrition. Health education should find a prominent place in the programme of study for physical instructors, the aim being to develop in them the incentive and the ability to train children to practise healthful living and to enable these teachers to co-operate intelligently in medical inspection.

### OPENING ADDRESS BY COLONEL W. C. SPACKMAN, I.M.S., INSPECTOR-GENERAL OF CIVIL HOSPITALS, BIHAR, AT THE SCIENTIFIC SECTION OF THE FIRST BIHAR PROVINCIAL MEDICAL CONFERENCE

I FEEL it is an honour and a privilege to be asked to-day to open the Science Section of the Bihar Branch of the Indian Medical Association here in this the headquarters of the Province where so many of you began your medical careers, and to welcome so many members of our great brotherhood of service.

There are always so many problems before us as doctors, not only those of our hospitals, dispensaries, public health services, medical education and other problems of general organization but medico-social and medico-legal questions. There is also the immense and ever-widening horizon of medical research, the quest for ever new and improved drugs and methods of treatment, and investigations into the diseases and disabilities we meet with in our general and special lines of medical practice.

That this conference will be able to make much impression on this vast unploughed field I fear is unlikely, but that is no reason for not trying.

There are one or two other aspects of these medical conferences which are of importance—and I speak as one who has in my time attended many such in a number of centres—in fact, I think I can truthfully call myself an experienced congresswala. Firstly, and of no little importance to the discriminating man, I would put down that one usually gets the chance of looking at a number of new preparations and appliances put out by the ever enterprising manufacturers and dealers in medical goods. Now, I would like to issue a word of warning on this subject to the younger members, for although I have picked up many and valuable new ideas and tips for new treatment from them I have also learnt not to be led away by mushroom concerns, mountebanks and ephemeral manufacturers of claptrap. Do not listen to their seductions however plausible they may sound. Take no heed of preparations and compounds whose composition and formulae are concealed nor of apparatus whose rationale is shrouded in mystery. Do not order them in order to experiment on your patients with them for if you do so you are debasing your calling to the level of these same medical mountebanks and swindlers and abandoning your right as members of a scientific and self-respecting profession. But if you go round with your eyes open and your critical faculties alert you can often learn a lot from the honest manufacturers, especially from the really well-known and reliable ones of long-established reputation who know that if they lend their names to a dud preparation they will forfeit the trust and respect it has taken them many years to build up.

And secondly, these meetings give one the opportunity of renewing old acquaintances and meeting old

friends as well as of making new ones. Personally I regard this aspect as being, if not perhaps necessarily the most profitable, at least the most enjoyable feature of these reunions. Looking back I realize that I have benefited greatly by the remarkable socio-professional opportunity thus afforded and incidentally that one's own professional prestige is often partly built up by these contacts.

But alas at the present time we have before us in addition to these pleasant considerations I have just enumerated many and urgent problems—let us hope only temporary in nature—connected with civil defence against cruel and treacherous aggression. We must not bury our heads in the sand as the ostrich is said to do. However much we may wish to get on with the study of questions of the greatest professional interest and to renew purely individual contacts, we can none of us shirk our share in giving our attention and assistance to those in authority who are trying their best to organize the resources of this great country in the face of a great peril. We must not forget that in addition to our private and professional interests and obligations we have as citizens our duties and responsibilities which it should be a privilege and let us hope a pleasure to discharge.

Whilst then wishing this Conference all success in its deliberations I appeal to you all not to stand aside from your civic and patriotic obligations but to offer your willing and united help to our common cause. Individually we can perhaps do little but there is work for one and all within the civil defence scheme and it is up to our doctors, both young and old, to prove themselves worthy of our noble calling.

I find it a little difficult at the present moment to bring to the task of opening this Science Section a mind devoted purely to science in the true meaning of the word, that is the advancement of knowledge for its own sake and for the benefit of the human race. Our thoughts are distracted by the terrible suffering and destruction deliberately brought about everywhere by using all the resources of science to this fatal end, and we may well ask with H. G. Wells whether *Homo sapiens* is not bringing about his own extermination off the face of the globe because he has gained knowledge too quickly without a corresponding adjustment of outlook from that of our forefathers of old when might was right and force the only law.

It is not science that is to blame, but human nature which has failed. When science was in its infancy it was not followed for these base ends; let us look back along its path of progress for a moment, to those days which might perhaps be called the golden age of the human race when the later Stuarts were reigning in England and the Taj Mahal was newly completed in Agra in all its loveliness.

The Royal Society came into existence in those years and King Charles the Second was one of its most enthusiastic founders; Isaac Newton was explaining the mechanism of the universe on a rational and modern basis. Intelligent people were being stirred and thrilled by new suggestions and new discoveries; they stood amazed in dawning consciousness of the wonder of it all. Science was the new baby to be made much of and fussed over, the centre of great interest, but the elder members of the intellectual family—music, art and literature—were not neglected, in fact we might say that that was the age when the giants lived, the giants of intellectual achievements never since excelled in stature.

In the nineteenth century great advances were made in pure science and in the scientific basis of medicine, and especially in science as applied to manufactures and transport. Even later we find the pioneers of aviation, Orville and Wilber Wright, Bleriot, Cody, Paulhan, Graham White and a host of others, all within my own memory, and all animated by a spirit of adventure and endurance without thought of the terrible uses to which their achievements would be put in later days, indeed so very soon after.

What a sorry picture meets our eye to-day, we who call ourselves the humble followers of the great pioneers of science, but trained in their traditions of service and healing. We see all the energies of almost the whole world bent on devising and producing in maximum numbers every possible engine and agent for destroying or weakening the opposing hosts. Science has gone ahead but ideals have clashed. Man has not learnt to use these great discoveries for the good of his fellows but only for their destruction. So long as we cannot agree among ourselves as to how the world should be run we can only think of battering at each other whilst our whole civilization sinks to annihilation and extinction.

But let us turn from this gloomy picture of the present only a few pages back to brighter days of personal memory. It seems but yesterday, though in fact it is 3 years ago, that I set out on a scientific tour of western Europe, the last of a series of similar very delightful tours. I found in Holland, in Belgium, in France, in Switzerland and Italy as well of course as in British research laboratories busily working on medical problems, well endowed and full of enthusiasm; hospitals and laboratories filled with doctors and scientists, men and women, whose whole attention and energy was concentrated on the pressing problems of endocrinology, nutrition, cancer research, all the workers eager to make headway for the relief of suffering and the stamping out of disease; all united in this common purpose.

To wrest from nature the secrets which have perplexed philosophers in all ages, to trace to their sources the causes of disease, to correlate the vast stores of knowledge that they may be quickly available for the prevention and cure of disease—these are our ambitions, declares Osler in one of his noblest addresses, and in these apt words he gives us the life-history of that splendid corps of scientific investigators to whom the world stands debtor to-day. William Harvey, the man who avowed himself the partisan of truth alone, diligently tracing out the circulation of the blood; old Anthony Leeuwenhoek, the Dutch draper, laboriously grinding out the first lenses which revealed the existence of micro-organisms, and paving the way for the brilliant achievements of a Louis Pasteur in France, a Joseph Lister in Britain, a Robert Koch in Germany, Humphry Davy and Horace Wells, Morton, Jackson and the great-hearted James Simpson, all sharing in the discovery of anaesthetics, those God-given drugs which enable the surgeon of to-day, in Weir Mitchell's immortal phrase 'with God-like will to decree the death of pain'; Laveran finding the malarial parasite, and Manson and Ross and Grassi, with infinite labour completing the whole story of malarial infection and its control; Castellani and Sambon performing the same service in the case of trypanosomiasis; Carroll and Lazear, Reed and Gorgas, ridding the world of its fear of yellow fever, as Jenner had rid it of the peril of smallpox; Roentgen and the other pioneers of radiography, their lives and limbs imperilled by the dangers of their work as their days were shadowed so often by controversy and persecution; James Mackenzie, working in humble obscurity for 20 long years at those laborious researches which have revolutionized our appreciation of cardiac disease; Ehrlich, that great plodding genius, adding experiment to experiment until he presents humanity with a means for destroying pathogenic spirochaetes; Domagk and hundreds of others following him introducing the new chemotherapy of the sulphonamides, certainly the greatest advance practical medicine has made in the last 30 years, perhaps its greatest in all the history of therapeutics, for are there not an almost unlimited number of chemical variants in this group? Fresh and more potent ones are being discovered and introduced every few months; the edge of this magnificent problem has but been touched but so brilliant are the results and so bright the promise that hopes are even now keyed up to the highest pitch of expectancy. If it were not for the war we might hope to find in the near future compounds in this series capable of successful application to all diseases of bacterial origin.

So we might continue, for the tale is not half told of the men and women whom the profession loves to honour; and yet the past teaches us that though wars and disasters and destruction spread their ravages till it appears that nothing worth saving remains, after it is all over it is found that in isolated corners and under conditions of the utmost difficulty, hardship and danger, the silent workers like faithful priests have been devotedly keeping alive the sacred flames upon the altars of science so that one day they may burn forth brightly again in the sight of all men for the healing of our grievous wounds and pitiable sores.

### THE FACULTY OF TROPICAL MEDICINE AND HYGIENE, BENGAL

THE following students are declared to have passed the D.T.M. Examination, session 1941-42.

#### *Passed with distinction*

1. Omkar Nath, M.B., B.S. (Punjab), private practitioner—Awarded the 'Chuni Lal Bose' Gold Medal 1942.

#### *Passed*

(Arranged in alphabetical order)

1. Brijpal Saran Agarwal, M.B. (Calcutta), private practitioner.
2. Machiandra Aiyama, L.M. & S. (Hyderabad), Medical Service, H. E. H. the Nizam's Government, Hyderabad.
3. Balbir Chand, M.B., B.S. (Punjab), private practitioner.
4. Amiya Kumar Banerjee, L.M.F. (Bengal), medical officer, Mujuni Tea Estate, Jalpaiguri.
5. Saroj Kumar Banerjee, M.B. (Calcutta), private practitioner.
6. Kedar Nath Basker, M.B., B.S. (Punjab), private practitioner.
7. Ajit Parshad Bhalla, L.C.P. & S. (Bombay), L.T.M. (Calcutta), sub-assistant health officer, district board, Jullundur.
8. Mahendra Jivanram Bhatt, M.B., B.S. (Bombay), private practitioner.
9. Benoy Bhusan Bhattacharjee, M.B. (Calcutta), medical officer, Duars Union Tea Co., Ltd., Jalpaiguri.
10. (Miss) Soonamai Nadirshaw Bulsara, M.B., B.S. (Bombay), Training Reserve Women's Medical Service, India.
11. Shib Nath Chakrabarti, L.M.F. (Bengal), private practitioner.
12. Ramesh Chandra Chakravartty, M.B. (Calcutta), private practitioner.
13. Bhola Nath Chatterjee, M.B., B.S. (Lucknow), private practitioner.
14. Narayan Chandra Chatterjee, L.M.F. (Bengal), private practitioner.
15. Sibabrata Chatterjee, M.B. (Calcutta), private practitioner.
16. Subodh Chandra Chatterji, M.B. (Calcutta), private practitioner.
17. Nand Kumar Chowdhury, M.B., B.S. (Bihar), private practitioner.
18. Abhaya Charan Das, L.M.F., L.T.M. (Bengal), sub-assistant surgeon, Government of Assam.
19. Nripendra Nath Das, L.M.F. (Bengal), assistant medical officer, Dunlop Rubber Co., Sahaganj.
20. Prafulla Ranjan Das Gupta, L.M.F. (Burma), L.T.M. (Bengal), private practitioner.
21. Kanai Lal De, L.M.F., L.T.M. (Bengal), private practitioner.
22. Sambhu Nath De, M.B. (Calcutta), private practitioner.
23. Chandrakant Tribhovan Rai Desai, M.B., B.S. (Bombay), private practitioner.

24. (Mrs.) Irene Lyall, M.B., B.S. (Punjab), assistant to the Professor of Medicine, Lady Hardinge College, New Delhi.
25. Jaiwant Vithalrao Gaikwad, M.B., B.S. (Bombay), assistant Palace Physician, Gwalior Durbar.
26. Manic Chand Ganguli, L.M.F. (Bengal), honorary assistant clinical pathologist, Calcutta Medical School Hospital, Calcutta.
27. Hari Sadhan Ghose, M.B. (Calcutta), private practitioner.
28. Jogendra Mohon Ghosh, L.M.F. (Bengal), assistant medical officer, New Purouphari Tea Estate, Assam.
29. Lalit Mohan Ghosh, M.B. (Calcutta), private practitioner.
30. Hira Lal Gupta, M.B., B.S. (Punjab), private practitioner.
31. Shanker Govindrao Joshi, M.B., B.S. (Bombay), private practitioner.
32. Kantesh Prasad Ram, M.B., B.S. (Bihar), private practitioner.
33. Gopi Krishna Khan, M.B. (Calcutta), private practitioner.
34. Baburao Narayan Kolekar, M.B., B.S. (Bombay), superintendent of dispensaries, Gird Circle, Gwalior.
35. Amar Nath Malhotra, M.B., B.S. (Punjab), private practitioner.
36. Triloki Nath Mathur, M.B., B.S. (Punjab), private practitioner.
37. Madhab Prasad Mitra, L.M.F. (Bengal), assistant medical officer, Ganges Manufacturing Co., Ltd., Bansberia.
38. Mohamed Amin, M.B., B.S. (Bombay), private practitioner.
39. Md. Lutfar Rahman, M.B. (Bengal), assistant surgeon, Government of Bengal.
40. Sunil Kanta Nandy, M.B. (Calcutta), private practitioner.
41. Brij Mohan Nath, L.M.F. (Central Province), L.T.M. (Calcutta), private practitioner.
42. (Miss) Paranjothy, Doddana Goud, M.B., B.S., D.O. (Madras), lady doctor in-charge, Mission Hospital, Azamgarh, U. P.
43. Dayanand Purshottam Patel, M.B., B.S. (Bombay), private practitioner.
44. (Miss) Evelyn Peters, M.B., B.S. (Punjab), private practitioner.
45. Nadimpalli Satyanarayana Raju, L.M.F., L.T.M. (Bengal), rural medical officer, Ambajipeta.
46. Gurbakhash Singh Sardar, M.B., B.S. (Bombay), medical officer, Nabha State.
47. Santosh Kumar Sen, M.B. (Calcutta), private practitioner.
48. Pinaky Prasad Sharma, M.B. (Calcutta), medical officer, Bir Hospital, Katmandu, Nepal.
49. Hasmukhlal Lilabhai Sheth, M.B., B.S. (Bombay), private practitioner.
50. (Miss) Mahendra Kumari Singh, L.M.F. (Bengal), resident medical officer, Matree Seva Sadan, Calcutta.
51. Shiva Shankar Sahay Srivastava, L.M.F. (Orissa), 3rd medical officer, Ranchi Sadar Hospital, Ranchi.
52. Ladli Prasad Tandon, L.S.M.F. (United Provinces), private practitioner.
53. Margaret Tison, L.S.M.F. (Punjab), L.T.M. (Bengal), private practitioner.
54. Vishwanath Anant Vanikar, M.B., B.S. (Bombay), private practitioner.
55. Harendra Keshore Verma, M.B., B.S. (Bihar), private practitioner.
56. Dhanvant Gajanan Vyas, M.B., B.S. (Bombay), private practitioner.
57. Swaroop Nath Wanchoo, M.B., B.S. (Punjab), private practitioner.

## Public Health Section

### PUBLIC HEALTH ORGANIZATION\*

#### I. INTRODUCTION

By W. P. JACOCKS, M.D., D.P.H.

*Regional Director for India and Ceylon, International Health Division of the Rockefeller Foundation*

TWENTY YEARS ago curative medicine and public health practice were widely separated subjects. The gap between the two was so broad that serious minded people were troubled by the thought that the breach might remain permanent. To-day in many health administrations curative medicine and public health practice are so intermingled that it is difficult to distinguish the one from the other. This backward swing of the pendulum may be no more permanent than its previous forwarded excursion and it is reasonable to conclude that the pendulum will come to rest permanently between the two extremes.

The present trend of unduly stressing treatment is the easiest way to obtain the interest of the people since they know nothing else about medicine, but it is inadequate; it is also unfair to the people themselves since it requires that they must become ill in order to receive health attention. Furthermore treatment has been given by practitioners from time immemorial yet none of present-day communicable diseases have ever been controlled by this method; and it was only when public health practices were introduced that progress in control of these diseases was observed.

It is admitted that the sick should be relieved. No medically trained person would discourage care for those who are ill and there are numerous medical facilities to deal with them. But such conveniences are insufficient for the needs of the whole people since they give service only to a small part of the population. If treatment is to be the prime procedure it seems that the greatest attention will be given to the state's liabilities (those who are ill) to the disadvantage of the state's assets (those who are well).

There is a wider viewpoint. To say that the average population of any country is too ignorant to co-operate in health measures is to admit an unwillingness on the part of the department to undertake a difficult task. It is now well known and has been repeatedly demonstrated in rural areas in many parts of the world, that if serious and adequate attention is given to the control of communicable diseases, to general

sanitation in its widest sense, to the physiology of pregnancy, to growing children, to nutrition and to personal hygiene that the vast majority of the village people will co-operate willingly and adequately.

There are many types of health organizations in India. The usual provincial public health organization in India consists of one Director of Health and one or more Assistant Directors. In three provinces and one state the organizations, both central and local, are developed by the provincial governments which control and co-ordinate the activities of its officers. This sound arrangement is in accord with the modern conception of public health practice. On the other hand, most of the provinces have a Director and a few Assistant Directors, whose chief duties are to inspect and advise. With few exceptions the rest of the health staff (medical officers of health, sanitary inspectors, health visitors, midwives) are non-official, that is they are employed by local bodies and are responsible to the local bodies who have no public health knowledge or experience and frequently no interest. No comment is necessary in regard to the danger of this situation. If local bodies are allowed to feel competent in directing health procedures the value of modern medical colleges and public health institutes must be reconsidered.

Health services are recognized as being of two classes, curative and preventive. Curative work has been in existence since the early days of the East India Company and at present well established and efficient organizations for treatment are found in all parts of India. Preventive work was recognized as a necessity about seventy years ago when Sanitary Commissioners were appointed to the Central Government and later to the Provincial Governments. The name was changed subsequently in the Provinces to Directors of Public Health and these officers have considerable independent authority. The present trend seems to be towards placing health work under the direction of medical practitioners who may have public health qualifications but whose experience in public health practice is limited or lacking. It would be unfortunate if this backward step should be taken.

It is considered to be administratively sound for curative medicine and public health to be under a single leadership provided the direction rests in a medical officer who has been especially trained and experienced in public health. By reason of his duties the general practitioner, the surgeon or other medical specialist cannot come into contact with the general population. It is unusual for him to know what is happening to the people as a whole in regard to communicable

\* We have invited contributions from a number of officers with special experience in different branches of public health service; we hope to publish these contributions from time to time in this section.

diseases, since he is accustomed to see only those who are ill and who seek his professional attention.

An officer qualified to carry on general public health work must have a good working knowledge of medicine and of all public health measures but he is no more qualified in the certain phases of public health work than the general practitioner is in ophthalmology. For this reason he needs assistants who have given special attention to particular subjects. The object of this paper is to describe a public health organization which is in common use in many modern public health departments and which is based on the curricula of public health institutes throughout the world.

Like all well-run businesses public health work falls into several well-known categories. For a long time it has been thought that a public health organization could function satisfactorily if at headquarters there were officers especially trained in four subjects: vital statistics, epidemiology, public health laboratory, and sanitary engineering. A diagram of this organization is appended and a brief statement is made concerning each division in the hope that this outline may be of aid to public health administrators in India.

*Vital statistics.*—This division keeps a record of populations, births, deaths and sicknesses. Many good reasons make it necessary for every person to have an official record of the time and place of birth. Death records are essential in respect to numbers and causes. The number of deaths gives data for calculating rates. The causes of deaths bring invaluable information. The relationship between births and deaths must be known in order to understand whether the general population is increasing or decreasing. In brief, vital statistics is the book-keeping of public health and unless the books are well and accurately kept the condition of the business will not be known.

*Epidemiology.*—This subject is sometimes given the heading 'Communicable Diseases'. The obvious thought is that this division will take care of epidemics caused by communicable diseases. This is only one of its duties. Were one to consider this phase alone he would think of this division as he does of a fire department which waits to respond to calls when fires occur. The real object of this department is to study epidemic diseases and learn something of their origin, their mode of spread, their occurrence in regular cycles, the population likely to be attacked, the geographical point from which the attack might come; in short, by a careful study of figures and events collected over a number of years, to have full knowledge of all epidemic diseases which are likely to occur in his particular territory. To illustrate: Suppose plague occurred in a neighbouring state. If the epidemiologist is alert, he will have this information early; he knows that plague follows grain routes;

he knows that he must place his staff at strategic frontier points to examine grain and if necessary see that it is cleared of infected fleas and rats before entering his state. In this way the danger of an epidemic will be halted at the frontier. But if the old system is followed the department would wait till the epidemic appeared and like a fire department would rush to extinguish the danger. The fire department eventually succeeds but at the expense of sickness and deaths and an enormous financial outlay. This department will look after all communicable diseases.

*Public health laboratory.*—This division undertakes all laboratory diagnostic work for the department and gives specific answers in respect to enteric fever, cholera, plague, malaria, filariasis, rabies and other communicable diseases. It verifies or refutes the clinical diagnosis made in the field. It supplements the work of the epidemiology division and works in conjunction with it. In addition it prepares vaccines against smallpox, typhoid, plague, cholera, as well as various sera. It carries on research. It examines the water supplies and determines the pollution of well water and springs. It is the division which is able to supply an exact answer to many public health questions.

*Public health engineering.*—This division has become of greater importance in recent years. The old idea that the sanitary engineer dealt only with water and sewage disposal is being abandoned, and malaria engineering, town planning, housing, ventilation, preparation of models for markets and slaughter houses are some of his additional duties. He is also responsible for general sanitation which includes inspection of markets, lodging houses and other duties performed by the sanitary inspector. For this reason a sanitary engineer to-day should be more than an engineer; he should have general knowledge of public health. Vaughan (1941), Commissioner of Health, Detroit, writes as follows:—

'Let us examine for a moment the character of this public health engineer who biologically is a variant of the sanitary engineer rather than the lay inspector. He should have received his basic training in the engineering and biological sciences. Our public health engineer should expose himself to the broad aspects of public health work taught at university level so that he may become conversant with the other technical fields which border closely upon his chosen avocation. The engineer should be conversant with the principles of biology and physiology. Architects will want advice on questions of housing, new building construction and old building remodelling, expressed in terms of air space, light, and heat to assure adequate ventilation comfort, and freedom from unwanted hindrances to the development and maintenance of positive health. Mechanical engineers will

seek advice in laying out plans for industrial plants, hotels and public buildings, so as to avoid the dangerous connections between polluted and safe waters, drains, and plumbing lines.

Food and milk inspection demand technical supervision, especially in designing and maintaining milk pasteurization plants void of mechanical imperfections, which engender false security and give the public an unwarranted sense of safety and freedom from milk-borne infection. Rodent and insect control require supervision by the public health engineer to ward off the encroachment of plague, typhus, epidemic, jaundice, and malaria, and to add to the general comfort and wholesomeness of urban life. Industrial hygiene is replete with tasks for our engineer, being a speciality with a physiologic basis abounding with engineering expression.

These statements by Dr. Vaughan refer particularly to a city public health engineer. They are of equal and perhaps greater importance to the provincial public health engineer.

It has already been stated that these four divisions furnish the basis of a public health organization. If they are well and properly developed the public health department will be a going concern and will meet most of the needs of any province or state in India. In many countries, including India, other trained personnel are required to deal with problems which one of the four departments would normally handle but which on account of their conspicuous importance require the full-time services of a particular officer. A few of these problems are, malaria, maternal and child health, rural health work, tuberculosis, nutrition, industrial hygiene and medical inspection of schools. It is probable that all except the first three subjects can be taken care of by the staff organization already described.

*Malaria.*—It has been stated that malaria causes 1,000,000 deaths in India each year. This is probably a conservative estimate. Malaria is generally distributed throughout India and it is a serious problem in parts of every province in this country. In malaria it is dangerous to generalize in regard to the methods of attack. The conditions under which malaria occurs vary widely owing to the difference in the physical conditions of terrain, to climate, to agricultural methods, to the vectors concerned and to many other factors. In view of the importance of malaria in causing ill-health it would be unwise for any public health department in any province in India not to have a malaria division directed by a well-trained and experienced officer. It is fortunate that there are good facilities in India for training such officers.

*Maternal and child health.*—The infant and maternal death rates are so high that special attention should be directed to them. A medical

officer of health trained in obstetrics and pædiatrics and supported by competent public health nurses and midwives will be required to direct this division and to prepare a plan of work including home visiting and clinics. This activity is an essential part of the official public health department and should be carried out by that organization.

*Rural health work.*—A better method than the ordinary district work should be evolved. The health unit offered possibilities and nothing has yet been suggested which is superior to this type of work. It has limitations which are largely due to the lack of suitably trained staff. It is not now recommended nor has it ever been recommended that the entire rural area of any province should be organized on health unit lines. But at least one organization should be established in each province, to be used as a training field for the public health staff and as a field laboratory for studying, testing and developing methods of procedure before applying them to the whole province or state.

Each of the divisions herein mentioned have been discussed only briefly, but each division is important and its activities could be elaborated into a full-sized paper.

The point which is always raised in regard to any public health organization is that it costs a lot of money. This is admitted. It is true that every worth-while activity costs money. Hospitals are expensive to erect and maintain; education calls for a big outlay; public works need large sums, but if the Government is interested the money will be found. If appropriations are indicators of interest it would be correct to state that many Governments in India even at this late day do not manifest much concern regarding public health or even agree that an investment in public health is a sound investment. Benjamin Franklin is said to be responsible for the old maxim: 'An ounce of prevention is worth a pound of cure'. Mathematical realists will at once conclude that it is sixteen times more costly to cure an established disease than to prevent its occurrence. Leaving proportional costs aside it is well known that viewed over a long period the practice of prevention is not only cheaper but far more satisfactory to the state and the people. This will be seen in a review of the costs of epidemics of plague and cholera and smallpox as compared with the financial and other satisfactions which have resulted in those areas where these diseases have been prevented. The value of prevention in respect to school health work could be cited. If properly carried out, the public health procedures in school health work will provide assurance that at the end of their education the student will find themselves physically and mentally sound. As a result they will constitute a healthy population which will be able to carry on the daily tasks more effectively to the benefit of themselves and hence to the country. Such



prospects, which are now uncommon, are worth large investments.

### Summary

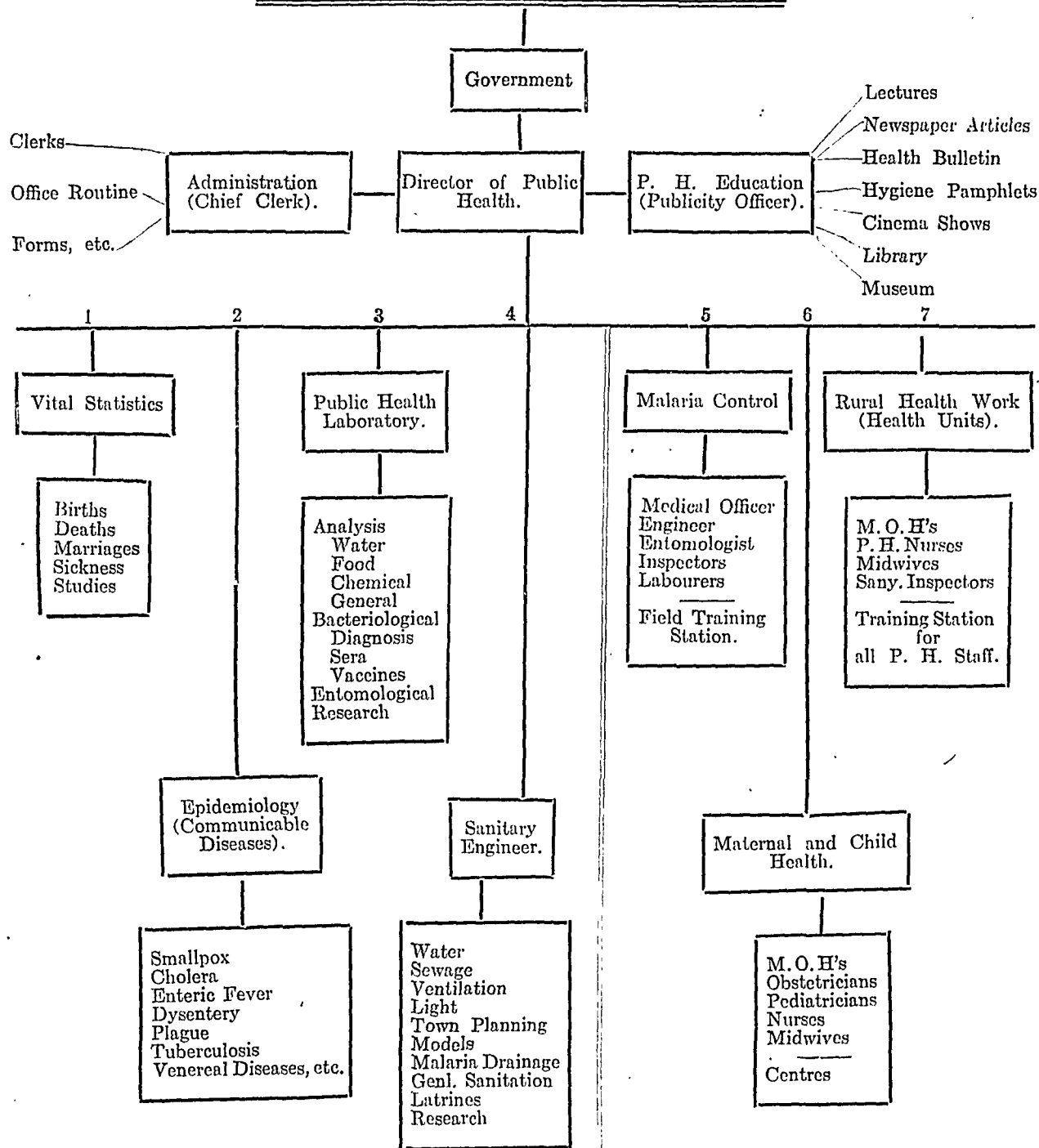
A brief discussion is given in respect to modern public health trends particularly towards treat-

ment. A type of public health organization, based on a chart, is described.

### REFERENCE

VAUGHAN, H. F. (1941). *Amer. J. Pub. Health*, **31**, 431.

### DIAGRAMMATIC SCHEME OF A PUBLIC HEALTH ORGANIZATION



## Current Topics

### A Survey of War Surgery

By L. R. BROSTER, D.M., M.Ch., F.R.C.S.

(From the *British Medical Journal*, Vol. II,  
23rd August, 1941, p. 273)

THE principles of surgery are continually being enriched by new methods which stand the test of time, but in wartime fresh problems are imposed with such insistence as to demand immediate attention, and often hasty improvisation. It has been delightful to see the enthusiastic reception which has greeted the presentation of our difficulties and the genuine desire to get to work on their solution which has been displayed by the profession both in the United States of America and in Canada. At the outset it may be said that the surgical principles laid down as a result of the last war have stood the test of time, and have remained the sheet-anchor of present procedures; but before surgery can be established on a satisfactory basis it is necessary to consider some of the points in its organization.

#### MEDICAL ORGANIZATION

The medical organization for this war has been devised on lines different from those of the last. The policy adopted has been the formation of the Emergency Medical Service for the whole country under the Ministry of Health. Hospitals have been decentralized and re-created as sector hospitals in the countryside, and are responsible for the treatment of sick and wounded, both civil and military, although the existing Service hospitals have carried on as usual. Many of these outlying hospitals have been converted into 'special hospitals', such as centres for head injuries, chest injuries, plastic surgery, and orthopaedic surgery. Before the war actually started the medical profession had been voluntarily conscripted. This work was undertaken by the British Medical Association. Every member was card-indexed and his wishes for service consulted, with the result that the Central Medical War Committee is able to satisfy from this pool any demand by the State in the way of personnel in any direction. The staffs of the voluntary and larger city hospitals have been used in manning the outlying sector hospitals. Apart from the inconveniences and the dislocation caused by the migration of large numbers of town folk to the countryside, the health of the population, in spite of rationing and overcrowding in shelters, has remained very good, and we have been free from epidemics. One of the anomalies has been that the health of the children who have remained at home has been better than that of those who have been evacuated. Although such a system has its limitations, as a wartime measure which has now become established it is running fairly smoothly and efficiently.

#### WAR WOUNDS

Early and free surgical excision still remains the basic, and most satisfactory, procedure in the treatment of all war wounds, and although the open Carrel-Dakin method is occasionally employed, the most important change has been the adoption of the closed-plaster method of Winnett Orr and Trueta and the use of drugs of the sulphonamide group for combating infection. The consensus of surgical opinion is that the combination of excision, closed plaster, and sulphonamides has proved a great advance in the treatment of war wounds.

Where this method has been used, as at Dunkirk, the wounded have arrived back in good condition and the wounds have been clean. It gives the maximum of comfort and eliminates many of the difficulties of

transport. Morale is high, and there is practically none of that distressing condition of 'shell-shock' which was so prevalent among the wounded from the trenches during the last war. There is no doubt that the closed-plaster method is a boon to the patient; it gives comfort and rest, and eliminates the dread of the painful daily dressings of the open method. Its greatest objection is the obnoxious smell. However, it requires constant supervision, for on the appearance of a raised pulse or temperature, pain, sleeplessness, loss of appetite, oedema, or coldness of the toes, the plaster should be removed. Where this close observation has not been possible some cases have arrived with spreading infection, sometimes anaerobic, and gangrene beneath the plaster. Under such conditions some surgeons prefer to transport their patients with a peeping window cut in the plaster over the wound, or, if the distances are short, to dispense with it altogether—as in such cases as fractures of the lower limb, in which the Thomas splint with traction has again proved its value.

With regard to sulphonamides, these can be employed in two ways—prophylactically, or locally into the wounds: by mouth, starting with 2 grammes followed by 1 gramme four-hourly up to a total of 20 grammes, or by direct insufflation into the wound in doses varying from 5 to 20 grammes. Experience has confirmed that more satisfactory results are obtained with local application. The chief aim is to get the wounded to the nearest surgical unit within twelve hours, and in these days of mechanized and aerial transport this ideal should be increasingly realized. In hospital the primary considerations are the arrest of hæmorrhage and the treatment of shock, whether primary or secondary. It is only then that excision should be carried out. This requires the removal, not too wide, of skin, all devitalized muscle and fascia, and detached fragments of bone and foreign material, so as to obtain a saucer-like wound, which is the most satisfactory for drainage. The more urgent call for early excision is in wounds of entry into fleshy parts with retained missile. In multiple wounds the larger ones only need be excised, as also those wounds complicated by fractures or involvement of joints. Although primary suture of the larger wounds after the application of sulphonamides may be carried out within twelve hours, the general impression is against this procedure. On the other hand, some surgeons have reported success from primary suture in wounds two to three days old, but as infection has already taken place in these late cases formal excision is not indicated: the wound should be opened to provide free drainage, necrotic muscle and retained missiles removed, sulphanilamide introduced, the wound covered with vaselined gauze, and the limb encased in plaster or splinted. When infection has been overcome secondary suture can be undertaken.

#### BOMB INJURIES

Fortunately the number of wounded has not come up to expectation; a higher proportion are mortal, however, and this is reflected in the low percentage of survivals from abdominal and chest wounds in comparison with the more numerous wounds involving the limbs. There is not so much of that extensive ploughing up of the tissues from high explosive and shrapnel as in the last war, for the modern bomb is more destructive than maiming. Its casing is comparatively thin, and its terrific blast breaks this up into numerous small hot fragments which spread out fanwise in a more or less horizontal direction with low trajectory. Wounding is more common from the secondary effects of the blast, either from shattered glass or from falling masonry. Consequently we may stigmatize this war of aerial bombardment as one of multiple injuries and marked traumatic shock. It is often difficult, therefore, to determine which of these small multiple injuries involve the more important structures, such as vessels, nerves,

and viscera; and they cannot be dismissed by their apparent triviality, for severe venous thrombosis may follow from infection driven into superficial veins, and nerve injuries in particular are apt to be overlooked.

#### REGIONAL INJURIES

It is impossible in a short paper of this kind to enter fully into the injuries of the different parts of the body, so a brief summary of the most salient points must suffice:—

**Head.**—Four principles of general application may be cited here: (1) Remove infective material and dead brain tissue. (2) Remove blood clot, extradural or subdural, and cerebrocele. (3) Consider whether a retained foreign body should be removed on account of traumatic epilepsy. (4) There is a definite impression that the sulphonamides tend not only to localize infection but to delay the necessity for operation: this is therefore a hint towards the adoption of more conservative methods. The most important fact to be established is whether the dura has been penetrated or not, and every means should be employed to this end. When the dura is opened damage to nervous pathways, spread of infection to the ventricles and basal cisterna, later abscess, and epilepsy must be borne in mind. The dural wound should not be enlarged unless the surgeon is prepared to remove necrotic brain and clot to prevent tension, otherwise fungus of the brain will develop. Forceful irrigation and suction should be used for this, and at the same time all dirt, foreign bodies, and detached bone must be removed. Repair of the dura is unsafe, and tension should be controlled by repeated lumbar puncture. Retained missiles should be left alone, but if the clinical signs spread and the cerebro-spinal protein content increases, bold measures for their removal should be undertaken. Compared with civil injuries, concussion is usually slight, but unconsciousness may occur late and be prolonged. Focal symptoms are frequent: they tend to recover, and operation is indicated only when they come on late.

**Abdomen.**—The mortality rate from abdominal wounds is high, and the principles of treatment remain fundamentally the same as during the last war. All undoubted peritoneal wounds must be operated on, and the mortality depends largely upon how soon this is achieved. Essentials for success are accurate localization of the missile, local patching instead of resections, and end-to-end anastomosis for preference, control of bleeding, cleaning out of the peritoneal cavity, and—rarely—drainage, except in the late cases, and then suprapubically. Time and speed, too, are essential. Multiple ileostomies are of no value, but caecostomy may prove a useful outlet for distension. Sulphanilamide dusted on the suture line and 5 per cent of this powder given with saline into the peritoneal cavity is a procedure that has been recommended by some surgeons. It is gratifying to hear that retroperitoneal hæmatoma, so fatal in the last war, has shown some recoveries with chemotherapy. Wounds of the liver, spleen, kidneys, and bladder should be treated on conservative lines. Abdomino-thoracic wounds, whether approached from the abdomen, thorax, or both, should ensure repair of the diaphragm. Late cases of peritonitis in which there is reasonable evidence of involvement of the bowel should be operated upon.

**Chest.**—Like wounds of the abdomen, chest wounds are of low incidence and high mortality. It is probable that a large number of these cases do not reach base hospitals. Operative intervention for hæmorrhage from the parietes or lung should be undertaken at once. Open pneumothorax is the bugbear of these sucking wounds, and must be stopped up at once by vaselined gauze dressings and strapped. Pressure pneumothorax can be gauged by trachea deviation radiologically and relieved by needling. Repeated aspiration should be performed for hæmorrhage, and, if infected, rib resection with closed drainage. Foreign bodies, unless large and in the dangerous area of the hilum of the lung and pericardium, are better left alone. For shock and loss of blood, plasma and whole blood are given in large quantities, up to 5 to 6 pints, the aim being to

maintain the hæmoglobin at about 80 per cent. Oxygen given by the B.L.B. mask is invaluable. Local application of sulphanilamide into the wound is good, but the results of employing it in the pleural sac are as yet inconclusive.

#### CHEMOTHERAPY FOR WAR WOUNDS

Perhaps the most fascinating aspect of the treatment of modern war wounds is the advent of chemotherapy as an adjunct to surgery. Though the use of these sulphur compounds must still be regarded as in the experimental stage, there is a general consensus of opinion that where they have been employed wounds are less heavily infected and in a healthier state than corresponding wounds in the last war. Much experimental work has been done with sulphanilamide, sulphapyridine, and sulphathiazole. Colebrook considers that local application is superior to the oral route, and has higher expectations from the use of sulphadiazine. Fleming prefers sulphathiazole. The effects of these drugs have been most notable in the streptococcal infections, especially in the cleaning up of late wounds. The anaerobic group as a whole is less susceptible to their action, but it is fortunate that *B. welchii* is more susceptible than the other members of this group. Antitoxic sera have also given protection against these infections, but at the moment no comparative results, or results from combined sulphur and toxin prophylaxis, are available. It is considered that these substances, of varying solubility, act direct on bacteria and arrest their metabolism.

#### BURNS

One of the curses of the internal combustion engine is the risk of burns, and the war has acutely accentuated the importance of this problem, which calls so much for team-work and treatment from different points of view. The tannic-acid method, devised by Davidson of Detroit in 1925, so successful before the war, led to neglect in the study of some of its pathological problems. War burns present special difficulties of their own, in which the primary objects are to save life and limb and to preserve function. The main cause of dissatisfaction with the tannic-acid treatment is that in the commonest types of burns—i.e., those involving the face and hands of airmen—it has led to severe scarring and to gangrene of the fingers. There has followed a great deal of ingenuity in trying out new methods of treatment, but as yet no unanimity of opinion as to their respective values has been arrived at. They may be summarized as follows:—

1. The Triple-dye Method.—This, consisting of gentian-violet 2 per cent, brilliant green 1 per cent, acriflavine 0.1 per cent, is recommended by Rear-Admiral Wakeley, who claims that when sprayed on the burn it produces less scarring than tannic acid.

2. The Bunyan Bag.—In this method the burnt surface is isolated in a special watertight envelope, and is irrigated with electrolytic sodium hypochlorite solution (5 per cent milton).

3. The Edinburgh school recommends the application of sulphanilamide and glycerine.

4. Saline baths.

If tannic acid has been found unsatisfactory for certain forms of burns it must not be concluded that it should be discontinued. Outside the areas of the extremities and flexures it still has firm and ardent advocates, and considered by many the best form of treatment when applied over a burn dusted with sulphanilamide. Whatever method is decided upon, the burnt area should be thoroughly cleaned with saline and dried with hot air. For this purpose gas-and-oxygen, evipan, and pentothal are the most satisfactory forms of anaesthesia. When the tan falls off in the course of a few weeks the part should be rubbed with lanolin, and any cracks in it can be dusted with sulphanilamide. Tanning has reduced streptococcal infection, but where this is present in late cases the tan should be removed and saline baths given. From the point of view of the plastic surgeon, the school led by Gillies insist that such treatment is satisfactory only for burns of the first and second degrees. For burns

of the third degree they recommend surgical excision of the burn, saline baths, and Thiersch grafting as soon as a satisfactory granulating surface has been obtained. By these means unnecessary scarring and deformity are avoided.

Apart from the treatment of the actual burn, it is in dealing with its complications that work is so desirable. Primary shock has a mortality rate of 2 per cent to 3 per cent, whereas secondary shock, which comes on later, has a danger-point during the subsequent twenty-four to forty-eight hours, with mortality as high as 60 per cent. Unless there has been concomitant hæmorrhage, blood transfusion is not indicated owing to the concentration of the blood which occurs, and blood plasma must be given to replace protein loss and prevent œdema.

#### BLAST INJURIES

The highly explosive force due to the sudden conversion into gases of solid material under great pressure within the modern bomb has given rise to a series of phenomena which have come to be known as 'blast injuries'. Blast has shown curious anomalies in its direction, distribution, and force. It is probable that these are due to the breaking of the casing at its weakest point and to the waves of pressure being ricocheted or reflected by buildings in the vicinity of the explosion. The effects of blast on animals have been studied by Zuckerman. A wave of high-positive-pressure velocity is created, and this is followed by another of negative decreased velocity exerting a suction-like action. The high-pressure wave falls to atmospheric pressure over a distance of some thirty feet, but proximity to the actual blast does not necessarily determine its effects upon its victims. Usually it gives rise to no surface injury, and is characterized by blood-stained froth at the mouth, which may appear sooner or later, but within ten days. Clinical examination of the chest reveals the signs of pneumonia. Necropsy discloses hæmorrhage of varying extent in the substance of the lungs. Similar hæmorrhages may also be found in the liver, spleen, intestines, adrenals, kidneys, bladder, and, seldom, the brain. The force of the blast may hurl people against objects and so give rise to secondary injuries, which may cause the blast injury to be overlooked. Fat embolism is also sometimes found at necropsy.

From the surgical point of view these patients give rise to much anxiety. Like pleurisy, the chest condition is often associated with rigidity of the abdomen, and yet due regard must be paid to the possibility of a concomitant intra-abdominal lesion, while in either case inhalation anæsthesia is best avoided.

#### CRUSH INJURIES

Different methods of warfare either bring new problems or revive old ones in new disguise, and the crush syndrome may well fall into either category. It is characterized by acute renal failure supervening in people who have been pinned down by fallen masonry and have been buried and subjected to pressure for a varying period. There may be no evidence of any local injury, but, when there is injury, local swelling, œdema, whealing followed by bullous eruption, and patchy areas of anæsthesia appear. A few hours later, in spite of vasoconstriction as shown by pallor, coldness, and sweating, the blood pressure falls and hæmo-concentration rises. Later the urinary output diminishes, and albumin and dark-brown clots appear in the urine. The patient becomes alternately alert and drowsy, and his blood pressure often rises. Œdema, vomiting, and thirst supervene, the blood urea and potassium become increasingly high, and death takes place about the seventh day. Post-mortem examination shows necrosis of muscle, and cloudy swelling and degeneration of the renal tubules.

#### SHOCK

'Shell-shock' to those who knew it during the last war has taken a holiday, and has been replaced by

traumatic shock of varying and severe degree; for, apart from wounds, it is a handmaiden to burns, blast, and crush injuries. There is little new to add to the question of shock; but from the observation of cases of uncomplicated shock at Charing Cross Hospital the following points may be stressed. The mental state of the patients, all of whom had received morphine, was quiet and still; very few of them were excited. In general they were pale, dry-skinned, and thirsty; one patient sweated profusely. Some had nausea and vomiting. The pulse was never above 100; its quality varied, being thin, impalpable, or collapsing. In all cases the blood pressure was below 100. A rise of 10 points in blood pressure, and improved temperature and colour and mental state, were taken as indications to warrant surgical intervention. As a rule the need for transfusion was in proportion to the severity of the injuries. Plasma was given, and whole blood if hæmorrhage had occurred. In severe shock transfusion may be difficult owing to the collapsed condition of the veins, and local warming of the arm has proved helpful in getting the blood in satisfactorily. The organization of the blood transfusion service has been one of the main successes of our hospital system, and the prompt access to reserves of stored blood has been most helpful and has resulted in the saving of many lives.

### The Drugs Used in the Treatment of Amœbiasis

By E. E. NELSON, M.D.

(Abstracted from *International Medical Digest*, Vol. XXXIX, July 1941, p. 54)

WHEN a number of different agents are in use in the treatment of a particular pathologic state or infection, none of these agents is completely satisfactory. In no field is this more true than in the treatment of amœbiasis. There are to-day three groups of substances generally recognized as having merit for use in this condition. These are: one of the alkaloids of ipecac, emetine; various halogenated quinoline derivatives, chiniofon, vioform, and diodoquin; and certain organic arsenic-containing compounds, carbarsone and acetarsone.

The ætiological agent is of course a particular species of amœba, *Entamœba histolytica*, which lives both in the lumen and in the tissues of the intestine, chiefly the large intestine, of human beings. Occasionally the lower part of the small intestine and the appendix may show evidence of injury. The species is normally a tissue dweller. The injury which is induced is at least in part due to a cytotoxicity of the cells in proximity to the invaders, with formation of lesions of all degrees of severity, from a superficial necrosis to deep abscess and ulcer formation. In these lesions and in the lumen the amœbæ live and multiply. If circumstances are unfavourable, cysts are formed which are passed in the faeces. These cysts are the usual infection forms for the next host. According to Craig the cysts are not resistant to sunlight or drying, so that contamination of food by dust is not possible. Not all who are infected with *Entamœba histolytica* develop symptoms severe enough to bring about medical examination and recognition of the invasion. Individuals in whom this is true may serve as carriers, and are potentially dangerous, especially if they are engaged in the handling of food. A relatively frequent and serious complication is liver abscess. In these abscesses motile forms are found.

Amœbiasis is by no means solely a disease of the tropics and subtropical regions, and because 'dysentery' does not always occur in cases of amœbic infection, diagnostic failures are common and significant.

To return to the problem of therapy and the agents available, one must consider not only relief of symptoms in the patient with frank 'amœbic dysentery',

but also the sterilization not only of these cases, but also of carriers, symptom-free or otherwise, and also the treatment of complications such as liver abscess. In order to get at the parasites, one must then have an agent which is absorbed and carried by the blood stream to the tissue invaders in sufficient concentration to be toxic for them, and which at the same time is present in the lumen of the intestine in amounts adequate to destroy both motile and encysted forms. This requirement is of itself difficult enough to meet, but at the same time the ideal therapeutic agent should be free of danger or discomfort to the human host.

It may be said at once that there is as yet no single substance available that fulfils the above requirements. At the same time it is possible by persistent and intelligent use of one or more drugs to cure a large per cent of the cases of invasion by this parasite. Therapy as practised to-day is a relatively new development. The oldest drug in use is emetine. It was isolated as early as 1817. Ipecac (ipecacuanha) had been used for many years in the treatment of dysentery, particularly by English practitioners in India, but not until 1910 were actually planned studies made of the action of ipecac and its alkaloids against the organisms of dysentery, both bacillary and amoebic. As a result of experiments by Vedder, Rogers tried the parenteral administration of the alkaloid and in 1912 reported 'the rapid cure of amoebic dysentery and hepatitis by the hypodermic injection of soluble salts of emetine'. Up to this time therapeutic advances consisted chiefly of development of methods for giving ipecac without causing nausea and vomiting. Rogers believed emetine to be as specific for amoebiasis as arsphenamine for syphilis, but considered opinion to-day does not rate emetine so highly. The experiences in the treatment of amoebiasis in the last World War revealed that many of the so-called cures by emetine were in fact followed by relapse. To-day it seems to be the general view that emetine is not an effective curative agent, but that for control of symptoms and for treatment of the complications it is excellent. Since it is usually given parenterally, some degree of absorption is insured, and the drug reaches the motile amoebæ in the tissues. For these it seems to be directly toxic, though the mode of action is not entirely clear. Earlier experiments in the test tube seemed to indicate a very low toxicity for the amoebæ, less than that of quinine, which is not an effective amoebicide. Later more accurately controlled work has shown that motile forms in culture may be killed by concentrations of emetine as low as 1:5,000,000. Just what concentration may be reached in the blood stream or in the fluid in liver abscesses, has apparently not been determined. At any rate the symptoms may be relieved, almost dramatically in some cases. But the encysted forms are not killed and probably motile forms in the lumen of the intestine are not all destroyed. At any rate relapse, which conceivably may be reinfection of the tissues by these lumen dwellers, is the rule. According to Faust, cure is induced by emetine alone in only about one-third of the cases. Used in the relief of abdominal distress and other gastro-intestinal symptoms, and in cases of liver abscess, the dosage usually recommended is 1 grain (0.065 gm.) of emetine hydrochloride in solution, subcutaneously, daily for 12 days. No further injections should be given for a period of one month.

Emetine is generally recognized to be a toxic substance, slowly eliminated, with potentialities for cumulative injury. Exact knowledge of the toxic dosage for human beings has not been worked out satisfactorily, although Leake believes they are of the same order as those found in laboratory animals. In these the lethal dose is about 25 mg. per kg. In view of the lack of satisfactory information caution should be followed and patients under treatment should be hospitalized.

The toxic effects which have been noted are: nausea and vomiting, severe diarrhoea with pronounced depression, cardiac irregularities and fall in blood pressure, muscular weakness with pain and tremors. A peripheral

neuritis with wrist or toe drop has been described, but also denied. In rabbits poisoned experimentally a definite injury to heart muscle has been found. In a general way one feels impelled to remark that the toxic effects of emetine do not seem to have been determined very clearly, and offer a field for investigation.

Since emetine is now recognized to have little action on the lumen dwellers or on the cysts, it is logical to think of administering some drug by mouth or by rectum that may reach these forms. For this purpose two groups of substances, various halogenated quinoline derivatives and organic arsenicals, have been used by both routes of administration. Regarding the relative effectiveness of the members of these two groups there is some difference of opinion. Craig considers chiniofon the safest and most effective substance, whereas Reed places carbarsone first.

Chiniofon, which is official in the U.S.P. XI in the form of the powder of chiniofon, a mixture with sodium bicarbonate, is a quinoline-sulphonic acid containing 1 molecule of iodine. It was introduced into medicine under the proprietary name of yatren, and has also been known as anayodin and by many other names. It contains about 27 per cent iodine and was originally introduced as a substitute for iodoform in wound disinfection. Later it was found to be of value in the treatment of amoebiasis. It has a very low toxicity for the host in therapeutic dosage. However, about 40 per cent of the patients may show a rather marked diarrhoea which may last several days. The method of administration recommended in the Department of Tropical Medicine at Tulane is to give four 4-grain tablets (0.25 gm.) after each meal for seven days. No special preparation is necessary and patients need not be hospitalized. The dosage recommended for children is 1 grain (0.065 gm.) three times daily for each 10 pounds of weight. If the stools remain positive for *E. histolytica*, the treatment may be repeated after a rest period of at least a week.

Two other substances similar to chiniofon chemically have been used for the same purpose with quite similar results. Vioform, also originally introduced as an iodoform substitute, is a chlorine instead of a sulphonic acid derivative of quinoline. Its percentage of iodine is therefore higher (about 40 per cent). It is not very soluble, and is also somewhat irritant so that it cannot be used rectally. It acts as does chiniofon on both motile forms and cysts. Reed rates it above chiniofon. The dosage recommended at Tulane is 4 grains (0.25 gm.) in capsules three times a day for 10 days; for children, 1/3 grain (0.020 gm.) per 15 pounds is given three times a day. This drug also is frequently followed by diarrhoea.

Recently a third iodine derivative of quinoline has been introduced for amoebiasis, namely, diodoquin. This material, which contains about 64 per cent of iodine, has been studied by several observers and found to be quite similar in action and results obtained. Again, to refer to the practice of the Department of Tropical Medicine at Tulane, Faust recommends its trial when two full courses of chiniofon have failed. The dose is from 22 to 30 grains (1.5 to 2.0 gm.) daily for two to three weeks.

The organic arsenical preparations now used in amoebiasis, like the quinolines, were introduced for treatment of other conditions. The only one in extensive use is carbarsone which Ehrlich introduced in 1909. In 1930 Leake and his associates demonstrated its value in experimental amoebiasis, and its relatively low toxicity by mouth. Subsequently Reed has indicated that this drug is the best therapeutic agent available. The dosage is usually 4 grains (0.25 gm.) twice daily for 10 days. Because of the recognized toxicity of arsenic compounds for liver and kidney, it probably is wise not to use this particular drug in the presence of evidence of disease of liver (including liver abscess) or kidney. Several authors have reported better success (fewer relapses) when oral treatment with carbarsone was combined with retention enemas of chiniofon.

# Reviews

## **PRE-ECLAMPTIC TOXAEMIA OF PREGNANCY.—**

By Lewis Dexter, A.B., M.D., and Soma Weiss, A.B., M.D. 1941. Little, Brown and Company, Boston. Pp. xviii plus 415. Illustrated

THIS monograph is the result of several years' observation on the part of one of the authors, and following this of intensive investigation into every aspect of the group of diseases which come under the heading *Toxaemia of Pregnancy*.

An enormous number of experiments have been done, carefully described, and the results tabulated. The functions of the liver, kidneys, heart and vascular systems have been carefully probed, and the effects of uncomplicated pregnancy, complicated pregnancy, and experimental pregnancy on these organs have been observed and correlated. But alas, out of all the work of which this book is the monument, the aetiology of this group of toxemias of pregnancy is as far away as ever. Yet it is the hope of the authors that though they may be said only to have clarified to a certain extent the syndrome of the toxemias of pregnancy, yet a detailed study of their efforts may clear up hitherto confused issues which may enable other workers in the future to open up our knowledge still further.

The book commences with a short but extremely interesting history of the disease as it was known from the days of Hippocrates, the 'Father of Medicine' having observed all the symptoms and signs which are to-day described as 'cardinal'. The dicta of such famous obstetricians as Mauriceau, who in 1740 stated that after the delivery of the child the mother's eclamptic condition got better, and Denman who in 1769 made the same observation as Mauriceau, but further stated that a too rapid delivery was contra-indicated in the interests of the mother, are detailed in the text. Many other famous obstetricians of earlier years are quoted, and finally those of the present time. Then follow the numerous items of experimental and research work with a complete bibliography.

The work is of course above the heads of the average under-graduate student, but is invaluable to specialists in obstetrics, especially to those who are teachers, and who merit the term, 'savant'.

H. E. M.

**MANAGEMENT OF THE CARDIAC PATIENT.—**By William G. Leeman, Jr., M.D., F.A.C.P. 1940. J. B. Lippincott Company, Philadelphia and London. Pp. xx plus 705, with 255 original illustrations (two of which are in colour). Price, 35s.

A SPECIALIST is so much engrossed with the technical aspects of the subject—for instance, a cardiologist with his electrocardiograph—that he is liable to overlook the management of an actual case. On the other hand, a general practitioner is so busily engaged in treatment that he has little time to take note of the rapid strides in electrocardiography and radiology in the diagnosis, treatment and prognosis of heart disease. The author of this book has hit on the right point and has helped to fill this gap, by putting together various methods in the scientific investigation of a cardiac patient and the essentials in the management of the case.

The book begins with a brief consideration of the clinical methods commonly employed in arriving at a diagnosis of heart disease, succeeded by a chapter on heart failure. Next, the problem of rheumatic heart disease has been dealt with; in this connection the view that rheumatic fever, chorea or mitral stenosis does not occur in tropical climates can no longer be supported. Thereafter, the main features and management of various diseases of the heart have been considered, the account being thorough and

comprehensive. With regard to the recently advocated heparin-sulphapyridine therapy in sub-acute bacterial endocarditis, the author's experience has been most disappointing.

Paravertebral alcohol injections to relieve the pain of serious types of angina pectoris have been found to be safe and effective in expert hands. Beck's operation for coronary disease appears to have a future. The chapter on cardiac emergencies has been presented in a practical style that will prove very useful for ready reference. A small section has been devoted on social service in the treatment of heart disease. The book ends with the introduction to the study of electrocardiography. A knowledge of the fundamentals of this subject can no longer be disregarded by a progressive physician.

The volume is profusely illustrated, and there are many case reports with relevant discussions. By outlying the diagnosis and treatment of such a large number of cases, the author offers to the practitioner an example of practically every cardiovascular problem which he may encounter in practice.

This is an excellent book with a high standard of production that can be strongly recommended to the members of the profession.

R. C.

**ARTHRITIS AND ALLIED CONDITIONS.—**By Bernard I. Comroe, A.B., M.D., F.A.C.P. Second Edition. 1941. Henry Kimpton, London. Pp. 878. Illustrated with 242 engravings. Price, 42s.

THE book begins by the statement 'arthritis is one of our oldest and most neglected diseases'. If this can be said in America, what about it in this country? There is undoubtedly lack of facilities for proper care of our arthritic patients, many of whom are in a pathetic incapacitated state.

This is an excellent book. We welcome the second edition, the appearance of which in so short a period of time testifies its real demand.

Important changes have been made practically in every chapter. In addition, several new chapters have been written, incorporating all the latest developments on the subject. The book describes the methods of diagnosis and treatment of various types of joint disease, which are of practical value to the physician. Numerous quick reference summaries are given that will prove very useful to a busy practitioner in treating this disease. There are numerous illustrations that have been nicely reproduced.

Rheumatoid arthritis, in all its aspects, has been dealt with thoroughly. More than 100 pages have been devoted to a discussion of the diagnosis and treatment of backache and sciatica. There is a good account of various other subjects, such as physiotherapy, gold therapy, the rôle of vitamins, allergy and endocrine glands, degenerative joint disease, fibrositis, infective arthritis, etc. The last chapter deals with the use of sulphonamide preparations.

The book is a mine of information, and will prove to be a valuable addition to a physician's library.

R. C.

**A DIABETIC MANUAL FOR THE MUTUAL USE OF DOCTOR AND PATIENT.—**By Elliott P. Joslin, M.D., Sc.D. Seventh Edition. 1941. Henry Kimpton, London. Pp. 238. Illustrated. Price, 10s. 6d.

WE welcome the seventh edition of Prof. Joslin's *Diabetic Manual*, the predecessors of which have always been of great value to patients and doctors alike.

The book has mainly been written for the benefit of diabetic patients, not only for helping them in the proper understanding of the disease they are suffering from but also to enable them to vary their diet for themselves without constantly referring for such advice to their doctors.

The book contains a mine of useful information which is not only of value to the diabetic patients but to the junior practitioners as well.

The book deals with in a short space almost all the aspects of diabetic life so that if the information given



in the book is followed by patients they may expect to live the normal span of life with comfort.

The book has been thoroughly revised and contains illustrations which are both interesting and educative. We have no hesitation in saying that the book will be as highly appreciated as its predecessors.

J. P. B.

**PHARMACOLOGY AND THERAPEUTICS.**—By A. R. Cushny, M.A., M.D., LL.D., F.R.S. Twelfth Edition. Thoroughly revised by C. W. Edmunds, A.B., M.D., and J. A. Gunn, M.A., M.D., D.Sc., F.R.C.P. 1941. J. and A. Churchill Limited, London. Pp. 852. Illustrated with 66 engravings. Price, 30s.

CUSHNY will be remembered both for his work and for his book. The present authors who have been responsible for the last three editions of this book are maintaining the Cushny tradition, and the present edition is in every way the equal of its predecessors.

It is a sound and orthodox textbook and a very valuable book of reference. The reader in India may feel that perhaps the drugs used in tropical medicine might have had a little more special attention. Quinine, for example, is well treated, but there is very little about the other cinchona alkaloids. Again, one is a little disappointed not to find more about the antimony preparations, though the standard ones, neostibosan and urea stibamine, are mentioned. Carbon tetrachloride is described as being 'effective' in kala-azar; the statement may not be evidence of the writers' ignorance on the subject but at least it might mislead the student.

This Anglo-American book is published by Churchill and printed in America. As is the rule with books published by this firm, they have given us excellent value at a very moderate price.

**AIDS TO BIOCHEMISTRY.**—By E. A. Cooper, D.Sc. (Lond.), F.I.C., A.R.C.S. (Lond.), and S. D. Nicholas, B.A. (Oxon.), A.I.C. Third Edition. 1941. Baillière, Tindall and Cox, London. Pp. viii plus 240. Illustrated. Price, 5s.

WITHIN the last few years the advances in the field of biochemistry have been outstanding and hence the appearance of the third edition, about 3 years after its predecessor, is very welcome.

In the present edition several chapters, particularly chapters XI, XIII and XV, dealing with the subjects of enzymes, vitamins and hormone have been entirely re-written and expanded giving much newer knowledge to the reader.

A new chapter on sterols has been added and in it the author has made reference to carcinogenetic substances present in tar soot and some lubricating oils. It is also interesting to note in this connection that the author has made reference about the possibility of a relationship between tobacco smoking and the causation of cancer.

The book gives important practical and experimental methods very clearly and has in short dealt with the essential theoretical considerations without giving an embarrassing amount of details.

The book will be found useful to students of biochemistry not only as a manual for revision for purpose of examination but also as a laboratory guide for experimental work.

J. P. B.

**ANATOMY AND PHYSIOLOGY FOR NURSES.**—By W. Gordon Sears, M.D. (Lond.), M.R.C.P. (Lond.). 1941. Edward Arnold and Company, London. Pp. vii plus 376. Illustrated. Price, 8s.

THIS book has been written apparently with the object of simplifying the difficult subjects, anatomy and physiology, to a form in which the probationer nurse can readily assimilate the more intricate features.

Nevertheless, it seems to us that in many parts it is rather advanced for the junior nurse studying these subjects during the first twelve months of training.

It would be excellent for the senior student and also a good reference book for the trained nurse.

On page 87, figure 57, showing x-ray of shoulder, there is a misprint where the humerus is called the femur.

E. M. G.

## Abstracts from Reports

### ANNUAL REPORT OF THE EXECUTIVE HEALTH OFFICER, BOMBAY, FOR THE YEAR 1940

THE health conditions of the city during the year were decidedly better than what they were during the previous year. This fact may be judged from the total number of deaths which was 1,420 less than that registered in 1939. It is also noteworthy that the infantile mortality recorded during the year was the lowest since the year 1873.

The number of live births registered was 38,833, being 1,011 more than in 1939 and 6,189 more than the average of the last ten years (1930-39). The birth rate calculated on the census population of 1931 was 33.4 births per 1,000. The total number of deaths from all causes was 29,100, being 1,420 less than in 1939, 2,202 less than the average for the last five years (1935-39) and 443 more than that for the preceding decennium (1930-39). The death rate for the year per 1,000 of census population of 1931 was 25.0 as against 26.3 in 1939 and 24.4 the rate recorded for the decennium (1930-39). Thus the number of births during the year was more by 9,733 than the number of deaths. This excess of births over deaths was equivalent to 8.4 per 1,000 population calculated on the census of 1931 and was recorded ten times in succession. Before 1931 there was no such excess since 1866, the year in which birth records were instituted.

There was no death from plague during the year against 17 the average of the last ten years (1930-39). Smallpox caused 834 deaths against 201 in 1939 and 974 the average for the last decennium (1930-39). The disease was in an epidemic form from the first week of April to the middle of June. There were 6 deaths from cholera but they were all imported cases. The disease was absent during the preceding year and the average for the ten years (1930-39) was 18. Influenza was prevalent in a mild form in the city during the year and caused 42 deaths against 58 in the preceding year and 80 the average for the last decennium (1930-39). The deaths from diseases of the respiratory system numbered 9,441, being 1,331 less than in 1939 and 867 more than the average of the last ten years (1930-39). Tuberculosis accounted for 1,934 deaths as against 2,034 in 1939 and 1,793 the average for the preceding decennium (1930-39). Ninety-eight deaths were due to malaria, being 73 less than in 1939 and 13 less than the average of the last decennium (1930-39). There were 732 deaths from ague and remittent fever against 761 in 1939. The average number of deaths for the last ten years (1930-39) from malaria was 111 and from ague and remittent fever 1,259.

The deaths among infants under one year of age numbered 7,823 against 8,008 in 1939 and 8,168 the average for the last ten years (1930-39). The rate of infant deaths per 1,000 births registered was 20.4 as against 21.7 for the preceding year and 25.9 the mean for the preceding decennium (1930-39).

Compared with the decennial averages (1930-39) the total number of deaths shows an increase of 443.

### ADMINISTRATION REPORT OF THE KING EDWARD VII MEMORIAL HOSPITAL AND THE SETH GORDHANDAS SUNDERDAS MEDICAL COLLEGE, BOMBAY, FOR THE YEAR 1940-41

THE Seth G. S. Medical College began to admit students from June 1925 and the K. E. M. Hospital was opened for the reception of patients in February

1926. It is more than 15 years since both the institutions began to function. Fifteen years of useful service is a very short span in the life of an institution but an occasional retrospect of its past working helps to form a correct perspective in the light of which its future progress may be directed. With this object in view the following short account of the progress made by these institutions is given:—

#### THE HOSPITAL

The scheduled accommodation in the hospital was 304 beds in the beginning, out of which only 100 were fully equipped and available for patients in February 1926. By the end of March 1927 the total bed accommodation available was 267. This accommodation was raised to 310 in the beginning of year 1927-28. With the opening of the Nowrosjee Wadia Maternity Hospital in close proximity to the College on 13th December, 1926, the maternity section of the K. E. M. Hospital was closed as from 1st March, 1927. The closing of the maternity wards enabled the provision of separate wards for children who were till then warded in the female medical and surgical wards, respectively, and the increase of gynaecological beds from 20 to 35. On account of the marked popularity of the hospital within a short span of 3 years and the increased demand on its accommodation, the accommodation had to be increased from 310 beds to 334. Due even then to constant over-crowding in the wards, the scheduled strength of beds was increased from 334 to 354 in 1929-30 and was further increased to 370 in 1936-37. In spite of the successive increases in accommodation, there were still a large number of patients lying on the floor almost every day, year in and year out. The Corporation then thought it necessary to undertake a big scheme of hospital extension and at the same time decided to provide more beds for the floor cases thus increasing the strength of beds in the existing hospital from 370 to 426 which is the accommodation available at present. Under the extension scheme 106 more beds will be available.

The total expenditure incurred on the maintenance of the hospital during the year 1926-27 was Rs. 3,41,000. The cost per in-patient during the same year worked out approximately at Rs. 3-14-1 per day and the cost of the out-patient department worked at As. 0-7-2 per outdoor attendance approximately. The expenditure of the hospital has during the year 1940-41 increased to Rs. 6,11,669. The average cost per patient per day has now been reduced to Rs. 2-15-3 while that per outpatient attendance to As. 0-6-0 during the same year.

When the extension scheme is completed the total accommodation available in the hospital will be for 532 beds and in case of necessity as many as 580 patients could be comfortably accommodated in the hospital. Such an increase in bed accommodation will, besides giving medical relief to a large number of patients, add greatly to the facilities of the clinical instruction of the students of the Seth G. S. Medical College. At present each student has the sole charge of about 4 medical or surgical beds against the standard of 5 beds per student as prescribed by the Medical Council of India. When the extensions are completed the floor area in the outpatient department will be increased from 33,900 square feet to 64,500 square feet thus providing double and in some cases almost four times the area occupied by the existing departments, leading to great facilities of work and a quick disposal of patients.

#### THE COLLEGE

At the instance of the Trustees of Seth Gordhandas Sunderdas Charities the then Advocate-General offered to the Corporation Government Loan Notes of the face value of Rs. 12 lacs (which was subsequently increased to 14½ lacs) for endowing a Medical College in connection with the King Edward VII Memorial Hospital. The Corporation accepted this munificent offer. The construction of the college building was entrusted to the Tata Engineering Company which had also planned the K. E. M. Hospital. The College

is a handsome three storeyed building designed in 'E' shape. The cost of constructing and equipping the College, including the cost of land, came to Rs. 17,45,017.

At the start the affiliation of the College was provisionally granted by the University of Bombay for a period of 18 months from June 1925 in the Faculty of Medicine for the course of study prescribed for the Intermediate M.B.B.S. examination. The Government were pleased to notify their sanction to the Senate's recommendation on 3rd September, 1925. The College began work on 1st June, 1925, with very scanty apparatus, furniture and almost with no library and gymkhana.

The permanent affiliation of the College to the University of Bombay for the courses for the M.B.B.S. degrees was sanctioned by Government in August 1926. The College is also affiliated to the College of Physicians and Surgeons, Bombay, for all its examinations.

Progressively the College and the Hospital have been also recognized for post-graduate degrees and diplomas granted by the University of Bombay as well as for various examinations held by the London University, the Conjoint Board (London), Royal College of Surgeons (England), and for the D. O. examination of the University of Oxford. The College is also affiliated to the University of Bombay for under-graduate and post-graduate courses of study in the Faculty of Science in the subjects of Animal Physiology, Comparative Anatomy, Embryology, Bacteriology and Micro-biology.

The College was allowed by the University of Bombay to admit 60 students to the 1st year class in 1926, which increased to 70 in June 1931 and to 80 in June 1934. The number of under-graduate students has increased from 46 in 1925, with 6 women students, to 426 in 1941, which includes 75 women students. The number of post-graduate students in March 1941 was 84 including 5 lady students.

As the College has been making the maximum number of admissions in the 1st year class as allowed by the University in 1934 the number of students obtaining on the roll of the College is likely to remain constant at present. As already stated the number of beds available per student at the K. E. M. Hospital is less than 5, the number required by the Medical Council of India. It is therefore not possible to increase the number of admissions to the first year class with the present bed accommodation in the hospital though the demand for increase in the facilities for medical education in the Presidency is growing every year as can be seen from the fact that no less than 451 applications were received for a possible admission of 75 seats in June 1941; exclusive of the five seats reserved for C. P. and Berar students since 1936 under a special agreement with the Government of that Province. The Government pays the Corporation a subsidy of Rs. 500 per student, per year.

The total expenditure on the College in 1926-27 came to Rs. 1,79,839 which has now increased to Rs. 2,77,087 in 1940-41. The revenue of the College in the form of fees which amounted to Rs. 32,682 in 1926-27 has increased to Rs. 1,23,006 in 1940-41. The gross cost per student which worked at Rs. 1,788 in the year 1926-27 has now been reduced to Rs. 650 in 1940-41 while the net cost which was Rs. 1,471 in 1926-27 has declined to Rs. 361-5-0 per student in 1940-41.

*Museum.*—Thanks to the timely donation of Rs. 1,10,000 in Government Promissory Notes given by the Trustees of the late Seth Jamnadas Lallubhai Charities, it has been possible to build the Seth Jamnadas Lallubhai Pathological Museum which was completed on 31st October, 1933, thus affording for the Pathology, Hygiene and Forensic Medicine departments an exhibitional area of 9,484 square feet as against the original area of 4,575 square feet that was available in the first construction, and which has since been given over to the Anatomy Department where a large part is set aside for study of Comparative Anatomy. The space so provided for museum

purpose is already found too small to keep pace with the enthusiasm and work of the various departments and to meet the needs of instruction of students every corner and corridor space is now being utilized till more funds are available to complete the extension. The cost of constructing and equipping the museum came to Rs. 98,140. The amount by the sale of the securities of the face value of Rs. 1,10,000 came to Rs. 86,110. The rest of the cost was borne by the Corporation.

*Hostel for men students.*—This hostel was ready for occupation by students in June 1926 and in the beginning provided accommodation for 100 students and the cost of its construction and equipment came to Rs. 2,65,928.

*Hostel for women students.*—The construction of this hostel was undertaken in 1937 and the building was ready for occupation by women students in October 1938. The cost of construction and equipment came to Rs. 83,490. The expenses of this hostel in the year 1940-41 came to Rs. 4,171 while the income by way of rent amounted to Rs. 2,661. A resident Lady Superintendent lives on the premises.

*Research.*—In the first few years of the opening of the College the staff could not undertake research enquiries as the most important duty at that time was to organize and equip the various departments and to settle details regarding the instruction of students. Nevertheless a start in this direction was made in 1926-27 and efforts were made to secure grants or donations for the purpose from various sources. At present researches are carried on with the help of grants from the following funds and institutions:—

- (1) Indian Research Fund Association.
- (2) Seth G. S. M. College and K. E. M. Hospital Research Fund.
- (3) Bombay University.
- (4) Private Funds.

The Corporation were also persuaded to form a separate Fund under the Seth G. S. M. College and K. E. M. Hospital Research Endowment Fund. This Fund is found very helpful in taking up fresh inquiries and it is expected to exceed the sum of Rs. 40,000 during the course of the year 1941. Some of the members of the staff have been able to secure small grants for their researches from the University of Bombay every year. It is extremely gratifying to note that some members of the staff have volunteered contributions from their own pockets for the conduct of some of the researches. My grateful thanks in this respect are due to Drs. Purandare, Bharucha and Cooper who have each financed some of the researches conducted at this College, thus setting an outstanding example of the spirit of fostering original work both by personal direction and patronage. The amount spent on research up to 31st March, 1941, thanks to the generous help received from various sources, comes to over Rs. 83,000.

It has not yet been found possible to have a gymkhana pavilion and a playground. A plot at Naigaum has been reserved for the playground and the Corporation were pleased to make a provision for levelling the ground sometime ago. The plot at the Parel Tank area which is in Government possession was considered more suitable for the purpose and negotiations were going on for the transfer of the said plot to the Municipality. Just when the matter seemed to have been finally settled and the plot was to be handed over to the Municipality, the war broke out in Europe and the then ministry resigned. One does not know when this ground will now be made available for the use of the students. As however the need for the gymkhana ground is imperative, levelling of the plot at Naigaum and the construction of the gymkhana pavilion might have to be taken in hand shortly. Such needs cannot be put off indefinitely.

#### REPORT OF THE BOTANICAL SURVEY OF INDIA FOR 1940-41

GREATER use of the industrial section of the Indian Museum, Calcutta, has been made by the commercial

community in having some of their trade difficulties solved. Assistance has been given by furnishing notes and reports on economic plant products and by giving advice on substitutes for imported commodities.

The industrial section has helped particularly in a thorough study of developing an essential-oil industry, in investigating possibilities of cultivating a number of perfume-yielding plants and in finding sources of indigenous vegetable dye-stuffs, of certain resin, gum and tannin-yielding plants and several industrial products.

Among enquiries dealt with by the botanical survey are possibilities of manufacturing agar-agar and iodine from sea-weed, the nature and remedy of black and brown patches on the canvas supplied to the army, possibilities of the cultivation of tung oil (Chinese wood oil) plants, information on oil-yielding grasses and cultivation of large numbers of medicinal plants.

Nearly 3,900 specimens were identified and revised during the year. Only 1,075 specimens could be distributed and the loan of herbarium specimens for purposes of critical study was restricted to Indian workers. Among a large number of exhibits added to the already rich collection of specimens in the public gallery of the Indian Museum are samples of some important commercial fibres, certain crude drugs, common Burma timbers and plywood.

The number of publications relating to several branches of Indian botany increased during the year to 127 as against 77 in the previous year.

A bulk purchase of quinine sulphate from Java enabled the Government of India to resume distribution of quinine to the provinces and Indian States. The total of cinchona products distributed during the year was 52,303 pounds. The stock of quinine sulphate at the end of the year was a little over 267,700 pounds and that of bark and cinchona febrifuge 207,872 and 8,943 pounds, respectively.

#### ANNUAL REPORT ON THE HEALTH OF THE ARMY IN INDIA FOR THE YEAR 1940

THE general health of the personnel of the British Army during 1940 has not been so good as in the immediately preceding years. For officers, compared to 1939, there has been an increase of 98.4 in the ratio of admission to hospital per 1,000 of strength and 2.81 in the death ratio. For other ranks there has been an increase of 57.2 in admission to hospital, but the number of deaths per 1,000 of strength, at 2.77, remains almost the same as in 1939.

Among factors which may have effected the incidence of disease, is the demand for field medical units for overseas service, so that the establishment of regular medical officers and assistant surgeons has fallen to a level only just sufficient to maintain the administration of hospitals in India. Numerous and frequent changes in the medical charge of units and the inexperience of young medical officers have had an effect in lowering the standard of medical and sanitary supervision and in interrupting the continuity of anti-malarial work. The tendency to treat in hospital cases which would be treated as outpatients was also noticed in some districts.

The presence of a larger number of troops in the plains throughout the hot weather and autumn, intensive training and the necessity of moves throughout this period had an effect on the incidence of sandfly fever, malaria and dysentery. There was a marked increase in the movements of units, often through unhealthy districts, and the arrival of young drafts and of men unaccustomed to India was a factor which has materially affected the general health of British troops, especially as most of these men arrived during the hot weather and many were kept in the plains.

The general health of the personnel of the Indian Army also has not been so good as in 1939 or in the years immediately preceding. For officers there has been a slight increase, from 462.1 to 466.4, in the ratio of admission to hospital per 1,000 but 1940 registered

a decrease, from 14.75 to 13.25, in the average constantly-sick ratio per 1,000. For other ranks, however, there has been an increase of 95.0 in the admission to hospital ratio per 1,000 of strength and the average constantly-sick ratio per 1,000 has increased from 16.25 to 17.51. The death rate per 1,000 increased from 3.84 to 5.17 in the case of officers and decreased from 2.12 to 2.11 in the case of other ranks.

Considering that intensive training was in force, that there was a great deal of unavoidable overcrowding and that an unusually large proportion of the troops consisted of elderly reservists and youthful recruits, the health of the Indian Army during 1940 can be considered to have been satisfactory.

Malaria was the principal disease affecting both British and Indian other ranks, which showed a considerable increase in incidence as compared with 1939. In the Northern Command malaria once again resumed its position at the head of the list of diseases, after having been reduced below first place for three consecutive years. Without anti-malaria measures in this Command, which were effective, the admission rates might well have soared high.

The incidence of sandfly fever in British other ranks showed a further reduction during the year under review and reached one of the lowest figures ever recorded and there was a slight increase in the incidence of the enteric group of fevers and dysentery-diarrhoea group.

In Indian other ranks the incidence of smallpox further decreased from 0.2 to 0.1 per 1,000 of strength. The low rate of incidence of the enteric fevers was also maintained in 1940. It was below one per 1,000. There was a slight increase in the admission ratio of cerebro-spinal fever and dysentery-diarrhoea group.

Increase in the admission ratio of effects of heat per 1,000 of strength in British other ranks was from 2.3 to 6.1. Heat stroke showed an increase from 0.4 to 1.2 and heat exhaustion from 1.9 to 4.9. The practice of having reveille for troops in the hot weather later than was formerly the custom is considered to be beneficial. There is also a growing realization that it is better to keep the men actively employed during most of the day throughout the summer. The two serious outbreaks of heat exhaustion which occurred in the middle of the hot weather were reported from British units which had reveille excessively early and kept their men shut up in barracks most of the day. Owing to great increase in troop movements necessitated by war conditions, special measures were adopted to safeguard military personnel undertaking long train journeys in the hot weather.

Government military dairies, and the milk supplied by them, can be considered as having been very satisfactory during 1940. Considerable alterations, both inside and outside dairy buildings, are still, however, necessary before perfection is attained; but the standard of hygiene is, on the whole, improving each year. In all dairies a willingness to carry out hygienic recommendations, where possible, has been noticeable during 1940. The health of women and children in India owes a great deal to the high standard of milk supplied by these dairies.

During 1940 many medical officers were specially trained in advanced hygiene with a view to their becoming hygiene specialists. This training was carried out by means of lectures, practical demonstrations and by attachment to the office of deputy assistant directors of hygiene. This scheme proved to be a success and many competent hygienists were turned out during 1940. Special lectures and demonstrations on hygiene and sanitation were given to each class of emergency commissioned I.M.S. officers and I.M.D. personnel undergoing training at No. 1 Company I.H.C., Rawalpindi, throughout the year.

Very great improvements have taken place in the past twenty-five years in the water supplies of military cantonments in India; and these improvements are each year slowly being added to. The water situation in most stations of brigade size and upwards is now satisfactory, with a chlorinated pipe supply to the barracks.

There are still, however, some exceptions. Plans to improve the situation in these places have been held up owing to the war. The situation in the majority of the smaller stations is little changed from what it was twenty-five years ago.

The present year has shown a further increase in child welfare work among Indian troops' families. The barriers of caste and religion, though still present, are gradually being overcome; and probably the care of the sick in the Indian families' hospitals is one of the most potent factors in bringing about this change.

The welfare work consists of two principal parts; the treatment of the sick and the hygiene of health families. Both these parts are essential; and the remarks of the president of one welfare centre are worth quoting. He states that 'The Indian troops families' hospital is the greatest asset in promoting the welfare and contentment of the unit'.

### TRIENNIAL REPORT ON CIVIL HOSPITALS AND DISPENSARIES IN THE CENTRAL PROVINCES AND BERAR FOR THE PERIOD ENDING 31ST DECEMBER, 1940

THE number of hospitals and dispensaries rose to 392 [348]\* owing to the opening of 51 dispensaries, all in rural areas, and of the women's hospital at Gondia and the closure of 8 dispensaries. The number of beds rose to 2,583 [2,394], the largest increase being in the Irwin Hospital, Amraoti (38). The number of indoor and outdoor patients steadily increased during the triennium, the number in the last year of the triennium being 49,692 [44,290] and 4,346,175 [3,591,292], respectively. The number of surgical operations also rose to 345,194 [341,356].

Although 51 dispensaries were opened in rural areas, considerable leeway has still to be made up in affording medical relief to rural areas, particularly as the death and infant mortality rates in this province are the highest in the country. With a view to quickening progress to suit the local conditions Government decided to enlist the help of indigenous systems of medicines to fight disease, after considering the report of the committee appointed to determine the place which these systems should occupy in the scheme of medical relief provided by the state. Two schemes were formulated in 1939, one for the establishment of 83 ayurvedic and unani dispensaries at the rate of one per tahsil and the other for subsidizing a similar number of ayurvedic and unani practitioners to settle in villages. So far 46 such dispensaries have been opened and 39 practitioners subsidized. It is too early yet to assess the value of this innovation, but Government feels that the schemes have not had much chance of success in the absence of an informed supervising agency. Recently therefore the creation of a post of inspector of indigenous medicine has been sanctioned. Legislation for the establishment of a Board of Indian Systems of Medicine for controlling and regulating the practice of indigenous systems could not be completed before the suspension of the constitution.

Simultaneously with the above two schemes, another for subsidizing 22 allopathic medical practitioners (one per district council) was prepared, and so far 9 practitioners have settled in villages. The progress is slow and disappointing owing to dearth of practitioners willing to settle in rural areas where the scope of private practice is necessarily limited; but Government is convinced that the problem of medical aid in the countryside with its distances, lack of communications and absence of urban amenities cannot be solved until this initial aversion to settle in a village is successfully overcome.

As 52 per cent of the mortality in the province is caused by malaria alone it is satisfactory to note that there was a general increase in the number of malaria patients seeking hospital treatment. This was due to the larger supplies of quinine available because of the Government of India grant.

There are four tuberculosis clinics in the province and these, as well as the Pendra Road Sanatorium are

\* Figures in brackets denote previous triennium.

doing excellent work. Government notes with pleasure the tribute paid to the clinic at Nagpur by Dr. C. Frimodt Möller, the Medical Commissioner to the Tuberculosis Association of India, who described it as being undoubtedly one of the best tuberculosis clinics in India. The Provincial Tuberculosis Association has examined the suggestions made by Dr. Möller for improving the clinics and intensifying the anti-tuberculosis campaign and its recommendations are now being examined by Government.

The general tendency to become more hospital-minded is seen at its best in respect of leprosy. In 1936 the number of leprosy cases treated was only 1,390 while in 1940 the number was almost six times as large, viz, 7,849. The exact number of lepers in the province is not known but the number of cases seeking hospital treatment must be only a very small fraction thereof. The real problem in the attack on leprosy is the occupation of space in leper homes by burnt-out cases to the detriment of cases requiring treatment and hospitalization.

Yaws is widely prevalent in the aboriginal areas of the province and a cheap-plan dispensary has been opened at Bhamragarh in the Chanda district mainly for treating yaws cases. Recently a regular campaign for survey of the incidence of the disease and treatment of the patients by injections has been initiated in the aboriginal areas of the Chanda district out of the Government of India grant for the welfare of aborigines.

The Nurses' Registration Council has been constituted under the Central Provinces and Berar Nurses' Registration Act, 1936. The provisions of this Act which prohibit unregistered nurses, health visitors, midwives and *dais* from getting employment or practising have been applied to the whole province but it is apprehended that the paucity of trained *dais* specially in rural areas will make enforcement difficult in practice.

A scheme has been initiated for the improvement of the mental hospital, Nagpur, which has not kept pace with modern ideas of what a hospital of this kind should be. A six-year plan of improvement costing over rupees two lacs has now been drawn up and a total provision of Rs. 38,887 has been included in the current year's budget for increased staff, electrification, provision of iron cots for the patients, improvement of drainage, etc.

The period after the outbreak of the War has been a difficult one for the department, which had to carry on with a staff greatly depleted in strength owing to the deputation of officers of all ranks for military duty.

## Correspondence

### THE POTENTIAL DANGER OF *ANOPHELES LEUCOSPHYRUS* IN ASSAM

SIR,—The observations recorded by Clark and Choudhury (1941) are interesting as they show that *Anopheles leucosphyrus*, which has so far been regarded as harmless, may in certain localities prove an important carrier of malaria in Assam. Although the number of dissections are small, nevertheless the comparative statement of sporozoite indices of *A. leucosphyrus* and *A. minimus* published by these authors is sufficiently illuminating in regard to the susceptibility of the former to plasmodial parasites of man. Whether or not insufficiency of the number of cattle in Digboi has been responsible for the change from zoophilism to androphilism in this species must be at present regarded an open question.

Our experience in a locality at the foot of the Naga Hills near Dimapur suggests that under certain circumstances, which are insufficiently known, *A. leucosphyrus* may prove potentially dangerous. This place was visited by us during the rainy season in connection with a severe epidemic of malaria (some cases ending fatally) that occurred among the immigrant European and Indian population who were

employed in a prospective oil mine. The camps of Indian employees were erected on hills about 100 to 300 feet high while those of Europeans were on a higher hill 500 to 700 feet.

There was no water-logging on the hills and all the breeding of mosquitoes was taking place in the streams and in numerous pools, ditches and *mullahs* at the foot of the hills which were covered with large and small trees and also shrubs. As the growth of vegetation was not so dense as to shut out the sun completely, it presented conditions ideal for the breeding of *A. minimus* and *A. leucosphyrus*.

Among wild mosquitoes caught in camps of Indian employees, those which incriminated with malaria were *A. minimus* in very large numbers. *A. leucosphyrus* were also obtained but in smaller numbers. *A. minimus* were curiously absent in camps used by the Europeans. Here a large number of *A. leucosphyrus* were captured. That this species was particularly prevalent in the European camps was confirmed from the catches of wild mosquitoes made by them in their camps for some days prior to our visit. As *A. minimus* was persistently absent in the higher camps, we were led to believe that *A. leucosphyrus* was the only species to be reckoned with in connection with the outbreak of malaria.

Though the mere presence of a species in the dwelling house does not necessarily point to its guilt, yet under the circumstances recorded above we were obliged to take notice of the potential danger arising out of the presence of *A. leucosphyrus* which had so far been considered harmless, although the extent of such danger could not be determined by dissection. It is interesting to point out in this connection that the androphilic index of *A. leucosphyrus* recorded by Ramsay and his collaborators (1936) in Assam was 75.5 as compared with 85.7 for *A. minimus*, though the receptivity of the former to plasmodial infection in Cachar (Strickland 1929, Ramsay 1930, Savage 1933) and in other localized areas in Assam has been proved to be insignificant.

Although in its breeding habits and in its tendency to be attracted to man there is a close similarity between the Indian and the Far Eastern types, it has nevertheless been strongly suspected of acting as a carrier in the Dutch East Indies, especially in Sumatra and Borneo. Both in wild mosquitoes and in those experimentally infected, the development of the parasites has never been found to proceed beyond the oöcyst stage. The literature on this subject has been reviewed by Covell (1927, 1931) and Stoker (1934). Other reports on the finding of oöcysts in wild mosquitoes have been published by Doorenbos (1931), Farinaud (1938), and Lefebvre (1938). Experimentally they have been infected up to a certain stage by Robin and Toumanoff (1934) in Indo-China and Bais (1920) in Sumatra, though Green (1934) and Swellengrebel (1919) failed to infect them.

Regarding its feeding habits Walch (1932) recorded the presence of human blood in 99 out of 100 and Toumanoff (1936) in 18 out of 19 and also in 3 out of 3 mosquitoes tested.

D. N. ROY, M.D., D.T.M.

DEPARTMENT OF MEDICAL  
ENTOMOLOGY,  
SCHOOL OF TROPICAL MEDICINE,  
CALCUTTA.

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### PELLAGRA IN THE UNITED PROVINCES

SIR.—With reference to the article on the incidence of Pellagra in the United Provinces by Dr. N. Ahmad, published in the March issue of your esteemed journal, I would like to draw his attention to the review by Dr. T. K. Raman (1940) in the *Journal of Indian Medical Research*, Vol. XXVII, p. 743, where he has also given a good survey of the incidence and symptomatology of pellagra in India and Burma, based on an analysis of 150 recorded cases.

I would like to draw his attention also to a case report published by me (1941) in the *Patna Journal of Medicine*, Vol. XVI. His statement that no cases have so far been reported from Bihar, therefore, does not hold good. At present I have another case under my treatment in my ward. Once the interest is created, more cases will be detected.

I fully agree with Dr. Ahmad's view that intensive nicotinic acid therapy gives uniformly good results in all stages and varieties of the disease.

S. K. GHOSH DASTIDAR, M.B. (Cal.),  
M.R.C.P. (Lond. and Edin.), D.T.M. (Cal.),  
*Lecturer in Medicine, Prince of Wales  
Medical College, Patna.*

PATNA,  
2nd April, 1942.

### SURGICAL COMPLICATIONS OF FILARIASIS

SIR.—The article on filariasis by Dr. P. N. Ray, in the April number of the *Indian Medical Gazette*, has just come to my attention and I have read it with a great deal of interest. In addition to the drugs mentioned there for the treatment of this disease I would like to suggest one more which we have used at this hospital for a number of years with considerable benefit to the patients, namely, urea stibamine. The dosage is about the same as is used in the treatment of kala-azar, and 10 to 14 injections are given.

It probably cannot be claimed that this drug can cause a complete cure of filariasis, but in most cases it does produce a marked decrease in the fever, swelling and adenitis, with definite relief of the suffering which these patients have to endure. In our opinion it gives the best results of any of the drugs we have used in the treatment of filariasis and has the advantage of being so low in price as to be available to the poorer classes of people.

BENAGARIA CHRISTIAN  
HOSPITAL,  
BENAGARIA P. O.,  
DIST. SANTAL PARGANAS,  
29th November, 1941.

Dr. S. Sundar Rao, the filariasis research worker at the Calcutta School of Tropical Medicine, comments as follows:—

E. OSTERGAARD, M.D.

'Various compounds of antimony such as foudadin (Bayer), anthiomaline (M.&B.), antimosan (von Heyden 661), stibosan (von Heyden 471), neostibosan (Bayer 693 b), Sdt. 561 (Bayer), stiburea (Union Drug Co.), novostiburea and antimony sulphur compound (Union Drug Co.), trystibine and stibilase (Meurice Belge) and A "534" (P. D. & Co.) were tried here at the School in the treatment of filariasis (*Indian Med. Gaz.*, LXIV, March 1929, p. 87, and *Indian Journ. Med. Res.*, 27, Oct. 1939, p. 549). None of these compounds had any lethal effect on the adult worm nor on the embryo. From the clinical point of view, some of these, for example, foudadin, gave good results and the frequency of the attacks of lymphangitis was reduced. But it is not always that we get good results from this treatment and the lack of uniformity in the results obtained makes us feel that antimony cannot be recommended for the routine treatment of filariasis. It would, however, be interesting to have some detailed data from Dr. Ostergaard regarding the number of cases he has treated, the dosage employed, the reactions observed and the actual improvements noted by him.'

## Service Notes

### APPOINTMENTS AND TRANSFERS

To be Honorary Physician to the King:—

Colonel R. Sweet, D.S.O. Dated 12th July, 1941, *vice* Major-General (local Lieutenant-General) W. H. Hamilton, C.B., C.I.E., O.B.E., D.S.P.

Lieutenant-Colonel W. M. Will, Deputy Assistant Director-General (Medical Stores), Madras, is appointed to officiate as Additional Deputy Director-General, Indian Medical Service (Stores), with effect from the 29th December, 1941.

The services of Lieutenant-Colonel A. S. Garewal, Superintendent, Central Jail, Nagpur, have been placed at the disposal of the Government of India, Defence Department, for military duty, with effect from 1st February, 1942.

The services of Lieutenant-Colonel A. S. Fry, Civil Surgeon, Simla East, are replaced at the disposal of the Government of the Punjab, with effect from the afternoon of the 5th February, 1942.

Major G. Milne, an officiating Agency Surgeon, on return from leave, resumed charge of his appointment as Medical Officer in charge of the Crown Representative's Police Force Hospital, Neemuch, with effect from the forenoon of the 1st February, 1942.

Major S. Smyth is appointed Civil Surgeon, Simla East, with effect from the afternoon of the 5th February, 1942.

### INDIAN LAND FORCES (Emergency Commissions)

The undermentioned Captains (on probation) are confirmed in their rank, with effect from the dates specified:—

P. L. Burman. Dated 2nd June, 1941.

T. S. Oberoi. Dated 5th June, 1941.

K. C. Varma. Dated 5th July, 1941.

L. Oswald. Dated 6th July, 1941.

M. S. Bazaz. Dated 19th July, 1941.

P. K. Gupta. Dated 3rd August, 1941.

The undermentioned Lieutenants (on probation) are confirmed in their ranks, with effect from the date specified:—

D. R. Desai. Dated 1st February, 1941.

5th June, 1941

M. Q. Ali.

Y. D. Deshpande.

N. M. Kalapesi.

T. N. Chacko.

J. Pakiam.

G. D. Agarwal.

G. W. Keswani.

J. C. Chakrabarti.

A. K. Das Dastidar.

V. K. Sundaram.

B. S. Nagra.

S. K. Suri.

M. A. Khan.

A. D. Paul.

J. L. G. Pinto.

M. A. Jan.

P. S. Raghavan.

G. D. Shenoi.



D. P. Ray.  
S. C. Srimani.  
J. K. Bose.  
J. E. G. Baker.  
M. V. Singh.  
C. S. Venkatasubramaniam.

C. S. Tamboli.  
P. V. Krishnan.  
D. S. Khatri.  
N. F. Lilauwala.  
K. Singh.  
M. C. Muniswamy.  
G. D. Joglekar.

6th June, 1941

A. K. Saha.  
P. K. Sen.

R. K. Chettur.  
K. S. R. Sarangapani.

R. Arunachalam.

7th June, 1941

B. Dyal.

5th July, 1941

B. N. Blaggan.  
B. A. Rao.  
H. R. Nischol.  
R. Sukumaran.  
V. K. Row.  
R. C. Biswas.  
J. S. Prakasa Rao.  
B. B. Prashad.  
K. S. Gill.  
J. K. Sarkar.  
G. G. Sahasrabudhe.  
V. A. Mauskar.  
M. Khan.  
R. N. Sen.  
S. D. Singh.  
C. R. Abrol.  
U. S. Sidhu.  
G. M. Diwan.  
P. Singh.  
K. G. Bhatia.  
R. N. Gupta.  
R. S. Tata.  
N. V. Subramanyam.

R. Krishnamurti.  
A. P. Thiagarajan.  
C. M. Nair.  
R. N. Aiyar.  
V. Sankaran.  
I. Jahan.  
C. L. Joshee.  
B. L. R. Chowdhury.  
A. K. Bose.  
Y. G. Joshee.  
D. Jayaram.  
L. R. Marthandam.  
M. V. Ramchandran.  
C. R. Mannadiar.  
K. Prabhakaram.  
D. F. Vachha.  
M. S. Mahadevan.  
A. G. Rangaraj.  
R. A. Jansen.  
P. A. Menon.  
N. Adiseshiah.  
T. R. Muthurangam.  
T. D. G. Sankar.

S. L. Bhandari.

6th July, 1941

P. R. Dutt.  
M. Hataṅgi.  
G. P. Halder.

R. S. Hoon.  
M. Mammen.  
C. F. Varied.

N. P. Mahapatra.

7th July, 1941

G. A. Naidu.

10th July, 1941

R. S. T. Rajan.

#### Emergency Commissions

The undermentioned appointments are made to be Lieutenants:—

George Vermilyea Faulkner. Dated 1st November, 1941, with seniority from 1st November, 1940.

Thomas Hallam Spencer Smith. Dated 8th November, 1941, with seniority from 8th November, 1940.

Alexander Dacre Dayson.

Phillip Jacobs.

Wyndham Moody Jones.

Duncan Anderson Maclean.

Francis Antony Whitlock.

#### LAND FORCES

##### To be Lieutenants (on probation)

George Henderson. Dated 5th December, 1941.

John Ogilvie Gordon. Dated 30th December, 1941.

Stanley Ferguson Thomas. Dated 5th January, 1942.

Dhanjishaw Dorabji Boovariwala. Dated 12th February, 1942.

The undermentioned Lieutenants (on probation) are confirmed:—

N. K. Mitra. Dated 1st July, 1940.

A. K. Dutta. Dated 15th February, 1941.

#### PROMOTIONS

Note.—The seniority of Captain J. Morgan in his present rank is antedated to 3rd August, 1936, and in the rank of Lieutenant to 3rd August, 1935.

#### INDIAN LAND FORCES

##### (Emergency Commissions)

##### Lieutenants to be Captains

N. K. Mitra. Dated 1st July, 1941.

G. B. Bowater. Dated 3rd July, 1941.

J. L. McCallum. Dated 24th October, 1941, with seniority from 3rd October, 1941.

J. M. Flower. Dated 2nd January, 1942.

3rd January, 1942

T. B. W. Phillips.

E. G. R. Butler.

J. F. McGarity.

N. St. G. Wade.

B. I. Evans.

R. Hermon.

C. M. Bisset. Dated 13th January, 1942.

A. W. B. Strahan. Dated 15th January, 1942.

D. Robertson. Dated 16th January, 1942.

D. R. Desai. Dated 1st February, 1942.

P. S. Fox. Dated 3rd February, 1942.

15th February, 1942

P. P. Rit.

M. S. Hashemi.

K. G. Koshi.

J. Chatterjee.

V. K. Pillay.

P. Subramanyan.

A. K. Dutta.

A. H. Minhas.

P. N. Roy.

C. L. Sukhija.

N. Khansur.

D. R. Shirhatti.

S. S. Sidhu.

R. Kaul.

B. C. Singh. Dated 17th February, 1942.

#### RETIREMENTS

Lieutenant-Colonel G. H. Mahony. Dated 22nd November, 1941.

Lieutenant-Colonel F. Phelan. Dated 18th March, 1942.

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## Original Articles

## THE TREATMENT OF KALA-AZAR BY DIAMIDINO STILBENE: ANALYSIS OF 101 CASES

By L. EVERARD NAPIER, C.I.E., F.R.C.P. (Lond.)  
P. C. SEN GUPTA, M.B. (Cal.)

and

G. N. SEN, M.B. (Cal.), D.T.M.

(From the School of Tropical Medicine, Calcutta)

**Introduction.**—About eighteen months ago, we (Napier and Sen, 1940) published a preliminary paper on the treatment of kala-azar by 4:4'-diamidino stilbene. At the time our paper was sent to press, there were in the literature—that had arrived in this country—only two detailed reports on cases treated by this drug (Adams and Yorke, 1939; and Adler and Rachmilewitz, 1939). Since then a small spate of reports has appeared. Kirk and Sati (1940) treated 8 cases of Sudanese kala-azar with remarkable success. Adams and Yorke (1940) treated a second case of Indian kala-azar. A further report by Kirk and Sati (1940a) referred to the treatment of 28 cases by this drug—this number presumably included the original 8 cases previously reported—and another 16 cases treated by allied compounds—the 'immediate-cure' rate was 86 per cent. Wingfield (1941) treated one case by diamidino stilbene and Adams (1941) a case by diamidino-diphenoxypentane. In trypanosomiasis, it has been used with success by McLetchie (1940), Harding (1940) and Bowesman (1940).

All report good results.

Recently, we (Napier and Sen Gupta, 1942) reported certain unusual neurological symptoms in 7 cases, following the use of this drug.

We have now treated a hundred cases of kala-azar and, as the drug may be considered by many to be still in its trial stages, we feel that we ought to report our experiences with it and make some attempt to appraise its true value as an anti-kala-azar drug.

**The patients.**—All except one were patients in the Carmichael Hospital for Tropical Diseases under the charge of the senior writer.

**Racially,** they can be classified as follows:—

|               |    |    |    |
|---------------|----|----|----|
| Indians       | .. | .. | 85 |
| Anglo-Indians | .. | .. | 13 |
| Europeans     | .. | .. | 2  |

100

**Sex.**—Eighty-seven were males and thirteen females; the preponderance of the latter is of course due to the fact that men came more readily to hospital and that in our hospital there are more beds for men.

**Age.**—Their age distribution was as follows:—

TABLE I

|                | Age incidence |                  | Age incidence |
|----------------|---------------|------------------|---------------|
| Up to 1 year   | 1             | From 21-25 years | 16            |
| From 1-5 years | 16            | " 26-30 "        | 12            |
| " 6-10 "       | 10            | " 31-35 "        | 6             |
| " 11-15 "      | 14            | " 36-40 "        | 9             |
| " 16-20 "      | 11            | " 41-50 "        | 5             |
|                |               |                  | 100           |

**Duration of illness.**—From the history of the duration of the disease the patients can be divided as follows:—

TABLE II

| Duration      | Number of cases | Duration       | Number of cases |
|---------------|-----------------|----------------|-----------------|
| Up to 1 month | 10              | 7-8 months ..  | 6               |
| 1-2 months .. | 9               | 8-9 " ..       | 1               |
| 2-3 " ..      | 10              | 9-10 " ..      | 2               |
| 3-4 " ..      | 10              | 10-11 " ..     | 0               |
| 4-5 " ..      | 6               | 11-12 " ..     | 15              |
| 5-6 " ..      | 8               | Over 1 year .. | 18              |
| 6-7 " ..      | 5               |                |                 |
|               |                 | TOTAL ..       | 100             |

The mean duration of the disease was  $8.22 \pm 3.05$  months, or about 8 months. In nearly half the cases the duration was over six months.

**Diagnosis.**—A diagnosis was made by demonstrating the parasite, in all except two cases; both these were children and quite clearly cases of kala-azar, in which for various reasons the attempt to demonstrate leishmania was not pursued.

The diagnostic procedures carried out and the results obtained were as follows:—

|                    | All | Smears + | — | Cultures only positive |
|--------------------|-----|----------|---|------------------------|
| Spleen puncture    | 32  | 28       | 4 | 3                      |
| Sternal puncture   | 78  | 69       | 9 | 1                      |
| Tibia puncture     | 2   | 1        | 1 | —                      |
| * Peripheral blood | 1   | 1        | — | —                      |

Sternal puncture was done in 78 cases, of which the smears were positive in 69. That is to say, in 9 (or 11.54 per cent) cases no leishmania was found by this method.

Spleen puncture was done in 32 cases, of which 28 showed parasites in the smears, and the other

\* This observation was made when a blood count was being done. Search for leishmania in the peripheral blood was not carried out as a routine procedure.

3 on culture only; that is, in 4 (or 12.5 per cent) no leishmania was found in the smears.

On superficial examination, this would appear to imply that the two methods of examination were equally reliable, but this argument is not valid.

Of the 9 cases in which the sternal puncture smear was negative, in 1 no further examination was done, as the culture of the sternal material showed leishmania, in 3 the spleen puncture smear was negative but the culture was positive, and in 5 the spleen puncture smear was positive. That is, of the 8 cases in which both spleen and sternal punctures were done, all the sternal puncture smears were negative, and 5 spleen puncture smears were positive and 3 negative. This certainly implies that spleen puncture is the more reliable method, but that when leishmania are scanty they may not be found in the smears obtained by either method.

In one child an unsatisfactory spleen puncture was followed by a satisfactory tibia puncture in which leishmania was found: this spleen puncture is not included in the table above as practically no cellular material was found on the film. In a second case the tibia puncture was negative, but the sternal puncture positive.

*Aldehyde reaction.*—This was done as a routine measure in every case, usually before admission, as a means of rough diagnosis. In 8 cases, it was completely negative. These were all early cases with small spleens, the largest being 3 inches below the costal margin: in one case (2) a long history of illness was given, but this was probably due to some other disease.

The findings are shown in tabular form below:—

| Reading              | Result   | Frequency      |
|----------------------|----------|----------------|
| +++ }<br>++ }<br>+ } | Positive | 41<br>21<br>12 |
| (+) }<br>± }         | Doubtful | 11<br>7        |
| (-) }<br>- }         | Negative | 2<br>6         |

#### *The blood picture*

A full blood count was done on admission and at least once again, and usually at the time of discharge. A few of the features of the count are analysed.

*Hæmoglobin.*—This was done with the Hellige hæmoglobinometer; the results were recorded in grammes of hæmoglobin per 100 c.cm. of blood. In over three-quarters of the cases the hæmoglobin was between 6 and 11 grammes; in 4 it was below 4 grammes and in 6 it was above 11 grammes. These last 6 might be considered to

be within the normal range, but far below the normal mean. Of the whole series, the mean and standard deviation is  $7.96 \pm 2.26$  grammes. The frequency distribution is given below:—

TABLE III

| Grammes of Hb. per 100 c.mm. of blood | Cases before treatment | Cases after treatment |
|---------------------------------------|------------------------|-----------------------|
| 2.1-3                                 | 3                      | ..                    |
| 3.1-4                                 | 1                      | ..                    |
| 4.1-5                                 | 8                      | ..                    |
| 5.1-6                                 | 6                      | ..                    |
| 6.1-7                                 | 17                     | ..                    |
| 7.1-8                                 | 12                     | 1                     |
| 8.1-9                                 | 18                     | 5                     |
| 9.1-10                                | 17                     | 14                    |
| 10.1-11                               | 13                     | 15                    |
| 11.1-12                               | 3                      | 23                    |
| 12.1-13                               | 2                      | 12                    |
| 13.1-14                               | 1                      | 17                    |
| 14.1-15                               | ..                     | 5                     |
| 15.1-16                               | ..                     | 2                     |
| TOTAL ..                              | 101                    | 94                    |
| Mean $\pm$ standard deviation.        | $= 7.96 \pm 2.26$      | $11.99 \pm 1.70$      |

(The final estimation is also given: reference is made to this later.)

*The size of the red cells.*—The frequency distribution of the mean corpuscular volumes (MCV) in the 88 cases in which this was calculated is as follows:—

TABLE IV

| Mean corpuscular volume in cu. $\mu$ | Frequency |
|--------------------------------------|-----------|
| 61-70                                | 1         |
| 71-80                                | 12        |
| 81-90                                | 30        |
| 91-100                               | 21        |
| 100-110                              | 8         |
| 111-120                              | 8         |
| 121-130                              | 7         |
| 131-140                              | 1         |

In only one case was the MCV below 70 cu.  $\mu$ , whereas in 24 it was above 100 cu.  $\mu$ . In the whole series the mean was  $94.1 \pm 15.2$  cu.  $\mu$ . This is not significantly different from the normal mean MCV of  $90.49 \pm 7.90$  cu.  $\mu$  (Napier and Das Gupta, 1936) in a similar population, but it indicates that the general tendency in this disease is towards an increase in the size of the cell.

*Leucocytes.*—In 33 cases the total leucocyte count was below 2,000 per c.mm., in 76 cases, or in over three-fourths, it was below 4,000 per c.mm., and in only two cases was it above 8,000 per c.mm.

The distribution curve is given in the table below :—

TABLE V  
*Leucocyte counts*

| Range of leucocyte count in thousand per c.mm. | Frequency before treatment | Frequency after treatment  |
|--|----------------------------|----------------------------|
| 0.0-1.0  | 5                          | ..                         |
| 1.1-2.0  | 28                         | 1                          |
| 2.1-3.0  | 28                         | 4                          |
| 3.1-4.0  | 15                         | 8                          |
| 4.1-5.0  | 7                          | 9                          |
| 5.1-6.0  | 7                          | 13                         |
| 6.1-7.0  | 6                          | 18                         |
| 7.1-8.0  | 3                          | 8                          |
| 8.1-9.0  | 0                          | 7                          |
| 9.1-10.0                                       | 0                          | 7                          |
| 10.1-11.0                                      | 1                          | 6                          |
| 11.1-12.0                                      | 0                          | 5                          |
| 12.1-13.0                                      | 0                          | 1                          |
| 13.1-14.0                                      | 1                          | 3                          |
| 14.1-15.0                                      | ..                         | 0                          |
| 15.1-16.0                                      | ..                         | 2                          |
| 16.1-17.0                                      | ..                         | 2                          |
|  | 101                        | 94                         |
| Mean $\pm$ standard deviation.                 | 3.47 $\pm$ 2.15 thousands. | 7.36 $\pm$ 3.28 thousands. |

#### TREATMENT

The specific treatment was usually commenced within about a week of the patient's admission into hospital, after he had been given a few days to settle down to his new conditions.

Except in one case, to which reference will be made later, diamidino stilbene was the only specific drug given. The patient was usually allowed a full diet, unless he had hyperpyrexia or other symptoms, such as diarrhoea or dysentery, which contra-indicated this; symptomatic treatment was given for such conditions, but no treatment was given for concomitant infections, such as hookworm, until his anti-kala-azar treatment had been completed.

*Resistant cases.*—It became obvious very early in the series that the ordinary case of kala-azar was going to respond well to this treatment, so for a time we concentrated on 'resistant cases'. A 'resistant case' may be defined as one in which an ordinarily efficient course of treatment fails to effect a cure. There is certainly some latitude in the matter of deciding what constitutes an 'ordinarily efficient' course, but we usually accept 10 or more injections of neostibosan and 12 or more of urea-stibamine as satisfying this requirement; in most of the cases included in the resistant group at least this amount was given.

*Route and routine.*—The intravenous route was used in all but 5 cases; in these, intramuscular injections were given but they were very painful,

though the drug appeared to be equally effective by this route. The drug was dissolved in sterile distilled water to make about a 1 per cent solution. The injections were given daily.

*Dosage.*—We varied the dosage slightly from time to time, but in the vast majority we adopted the plan of giving to an adult 0.025 gramme as the initial dose, followed by 0.050 g., 0.075 g., 0.090 g., and 0.100 g., provided the reaction after each dose was not a very severe one, and provided the dose did not exceed 0.001 g. (one milligramme) per pound weight of the patient. If the patient weighed more than 100 pounds we proceeded to increase the dose by 0.020 or 0.010 g. up to the maximum of 1 milligramme per pound. With small children we started with a dose of 0.010 g. and increased it up to the maximum by 0.005 g. stages. This initial dose meant that a relatively much larger dose was given to children, but we found that they always stood it better. If reactions were severe, we repeated the dose; very rarely did it seem necessary to reduce it.

We did not aim at giving any definite total dose or any special relative (relative to weight) total dose, but gave a course of 10 or 12 doses in ordinary cases and sometimes increased this up to 15 in resistant cases. In a few cases a second course was given, so that the number of injections reached higher figures, and in a few others the course was curtailed for various reasons.

The drug was still in the experimental stages, and we hoped by thus varying the dosage to get some information regarding the minimum dosage necessary.

Any attempt to follow a set plan was prevented by the very variable reactions that were encountered in different cases.

The number of doses given in ordinary and 'resistant' cases is shown in the table below :—

TABLE VI  
*Number of injections*

| Number of doses | Ordinary cases | Resistant cases |
|-----------------|----------------|-----------------|
| 8               | 2              | 0               |
| 9               | 3              | 0               |
| 10              | 54             | 6               |
| 12              | 14             | 8               |
| 15              | 1              | 7               |
| 18              | 1              | 0               |
| 10 + 8          | 0              | 1               |
| 12 + 10         | 0              | 1               |
| 15 + 12         | 0              | 1               |
|                 | 75             | 24              |

The two patients who died are not included, and one patient who relapsed is reported as two cases.

The total dosage in the various cases is shown below :—

TABLE VII  
Total dosage

| Range     | Ordinary | Resistant |
|-----------|----------|-----------|
| 0.11-0.20 | 3        | 0         |
| 0.21-0.30 | 9        | 2         |
| 0.31-0.40 | 7        | 3         |
| 0.41-0.50 | 5        | 0         |
| 0.51-0.60 | 8        | 1         |
| 0.61-0.70 | 19       | 2         |
| 0.71-0.80 | 8        | 3         |
| 0.81-0.90 | 12       | 1         |
| 0.91-1.00 | 3        | 2         |
| 1.01-1.10 | 0        | 2         |
| 1.11-1.20 | 0        | 2         |
| 1.21-1.30 | 0        | 3         |
| 1.31-1.40 | 0        | 1         |
| 1.41-1.50 | 0        | 0         |
| 1.51-1.60 | 1        | 1         |
| 1.61-1.70 | 0        | 0         |
| 1.71-1.80 | 0        | 1         |
| TOTAL     | 75       | 24        |

The mean total dosage in the 75 cases was  $0.597 \pm 0.245$  gramme and in the 24 resistant cases was  $0.884 \pm 0.414$  gramme.

*The relative dose.*—This is calculated on a 100 lb. basis, that is, the total dose per 100 lb. body-weight. This dosage in the different cases is shown in the table below :—

TABLE VIII

Relative total dosage per 100 lbs. body-weight

| Range     | Ordinary | Resistant |
|-----------|----------|-----------|
| 0.41-0.50 | 3        | 0         |
| 0.51-0.60 | 0        | 0         |
| 0.61-0.70 | 3        | 1         |
| 0.71-0.80 | 16       | 2         |
| 0.81-0.90 | 21       | 3         |
| 0.91-1.00 | 17       | 3         |
| 1.01-1.10 | 3        | 7         |
| 1.11-1.20 | 2        | 0         |
| 1.21-1.30 | 5        | 5         |
| 1.31-1.40 | 2        | 0         |
| 1.41-1.50 | 1        | 1         |
| 1.51-1.60 | 0        | 0         |
| 1.61-1.70 | 2        | 1         |
| 1.71-1.80 | 0        | 0         |
| 1.81-1.90 | 0        | 0         |
| 1.91-2.00 | 0        | 1         |
| TOTAL     | 75       | 24        |

The mean relative total dose of the ordinary cases is  $0.912 \pm 0.224$  gramme and of the 24 resistant cases is  $1.009 \pm 0.293$  gramme.

#### Reactions

The general account of the reactions that occur has been given before (Napier and Sen Gupta,

(loc. cit.); we have quoted from this account below :—

A burning sensation all over the body, flushing of the face, transient difficulty in breathing, nausea, vomiting, epigastric distress, giddiness, palpitations, sweating and occasionally collapse.

The almost constant finding during and immediately after the first few injections of this drug has been a marked fall of blood pressure, both systolic and diastolic, the former to a greater extent than the latter. A drop of 20 to 40 mm. of mercury within a minute or two of the injection has been found in all cases showing the more severe symptoms, and the drop has been even greater in the patients who collapsed. The blood pressure rises to nearly the previous level in almost all cases within 5 to 10 minutes and with this rise most of the symptoms disappear. In the cases in which there are serious reactions, an injection of adrenalin raises the blood pressure almost immediately and the unpleasant symptoms subside. When in such cases an injection of adrenalin is given a few minutes before an injection, little or no fall of blood pressure takes place and the symptoms may be entirely absent.

The symptoms—giddiness, faintness, palpitations, sweating, epigastric distress and collapse—can be readily explained in most cases by this fall of blood pressure that results from the injection. If we regard the drug as having a histamine-like effect, the sudden fall of blood pressure and the symptoms associated with it, the flushing of the face, the hot sensation, the occasional burning sensation in the different parts of the body, and the dyspnoea can all be explained. The fact that adrenalin relieves these symptoms, also supports this point of view.

It was very rarely that the patient did not complain of some slightly unpleasant feeling which scarcely amounted to a reaction; a 'slight reaction' in the table means at least severe flushing and headache.

In 25 cases there was a severe reaction.

The following is a good example of a case in which a severe reaction occurred:—

Case 94.—The patient had been suffering from kala-azar for 9 months; weight 77 lb. The injections were commenced on the 10th September, 1941. The first dose of 0.025 gm. did not cause any marked reaction. The second dose 0.05 gm. gave rise to severe reaction; she collapsed, had convulsive twitches, the pulse was imperceptible, she became cold and clammy, the blood pressure fell from 112/84 to 50/16 (?). The heart rate became very slow. The patient was given 1 c.cm. of adrenalin hypodermically and artificial respiration. She rallied after 2 minutes. The rest of the injections were preceded by 0.25 c.cm. of adrenalin hypodermically and reactions were entirely absent with these injections. The patient had 10 injections—maximum 0.08 g. and the total dose was 0.625 gm.—and she was later discharged cured.

The dose which first caused the severe reaction was the second and it amounted to 0.65 mgm. per pound; subsequently, with the help of a very small dose of adrenalin she tolerated a maximum dose of over 1 mgm. per pound quite easily.

This was not the worst reaction that we experienced; this reaction occurred in an out-patient who was being treated for oriental sore. He received 0.05 g. (or 0.3 mgm. per pound) and became unconscious with loss of reflexes (*vide* Napier and Sen, loc. cit.).

The following case demonstrates how adrenalin given after the injection controls the reaction,

but given before, in very small doses, prevents them, and how eventually tolerance is established.

the second administration of the diamidino stilbene was less, though the dose was increased.

Case 44. A male Indian, weight 93 lb.

| Date    | Dose of diamidino stilbene | SYSTOLIC B.P. |       |            | DIASTOLIC B.P. |       |            | Reactions and precautions  |
|---------|----------------------------|---------------|-------|------------|----------------|-------|------------|--|
|         |                            | Before        | After | Difference | Before         | After | Difference |  |
| 26-6-41 | 0.05                       | 94            | 82    | - 12       | 60             | 56    | - 4        | Slight reaction.   |
| 27-6-41 | 0.075                      | 94            | 64    | - 30       | 60             | 32    | - 28       | Severe reaction, faintness, feeble pulse, burning sensation all over the body. Adrenalin 0.25 c.cm. given with relief. |
| 28-6-41 | 0.08                       | 100           | 112   | + 2        | 68             | 70    | + 2        | Adrenalin 1 c.cm. given before injection of diamidino stilbene. No reaction.   |
| 29-6-41 | 0.09                       | 106           | 108   | + 2        | 70             | 76    | + 6        | Adrenalin 0.33 c.cm. given before. No reaction.  |
| 1-7-41  | 0.10                       | 108           | 90    | - 18       | 76             | 45    | - 31       | Reaction—Adrenalin 0.33 c.cm. given after injection of diamidino stilbene—with relief.                                 |
| 2-7-41  | 0.10                       | 92            | 90    | - 2        | 66             | 66    | 0          | Adrenalin 0.33 c.cm. given before. No reaction.  |
| 3-7-41  | 0.10                       | —             | —     | —          | —              | —     | —          | Slight reaction. Adrenalin not required.   |
| 4-7-41  | 0.10                       | —             | —     | —          | —              | —     | —          | Ditto.   |

Case 30 is another case in which tolerance was established. In this case we were testing the value of atropine which we subsequently concluded had little or no effect on the reaction.

Case 30.—The patient had been suffering from kala-azar for about a year; weight 87 lb. Immediately after admission he developed pneumonia and was successfully treated with sulphapyridine. He was given 0.025 gm. of diamidino stilbene on the first day of the course of treatment for kala-azar. He had a very severe reaction, burning sensation all over the body, faintness, dyspnoea, sweating and palpitations. There was a marked fall of blood pressure and the pulse became very rapid (160/min.) and feeble. The symptoms subsided in 5 to 7 minutes and the blood pressure gradually rose. There was less reaction with the second injection, but the pulse became rapid and was soft. He was given an injection of atropine before the injection of diamidino stilbene, but this did not stop the fall of B.P. The severity of the reactions was much less at this time, and it progressively grew less, though no atropine nor any other drug was given. He was repeatedly given the full single dose for his weight (0.09 gm.) without any appreciable reaction towards the end of his course of treatment.

In 54 additional cases the reaction was noted as 'slight'.

Blood pressure.—The blood pressure, in those cases in which it was taken, appeared to be more or less parallel to the subjective symptoms. After a standard dosage was adopted, we took blood pressure readings in all cases for a time. These are shown in tabular form in protocol II. It will be noted that there was apparently a progressive fall in the initial blood pressure (see figure 1). The fall after

After a further increase in dose it appeared to be greater again; but later, when the dose was stabilized, the fall became progressively less;

1st 2nd 3rd Day

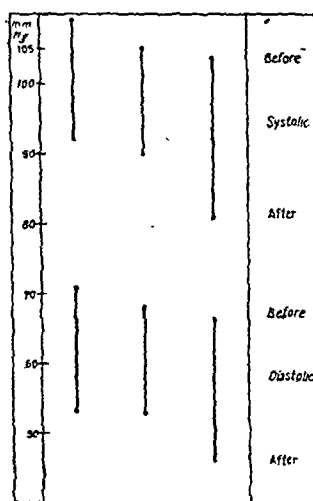


Fig. 1.—Showing systolic and diastolic pressures, before and after diamidino stilbene injections; mean of readings of 24 patients on three successive days.

this was only followed in a few cases, but can be deduced from the decrease in the reaction symptoms.

Control of reactions.—These reactions were obviously a serious complication to the administration of this drug and the problem of obviating them was important. We used adrenalin from the beginning to control the symptoms (Napier and Sen, *loc. cit.*) Wingfield (*loc. cit.*), apparently having overlooked our



earlier communication, suggests the use of adrenalin on the false (we believe) supposition that these symptoms are due to the fall of blood sugar. As early as 1937, Lourie and Yorke exploded the theory that the drugs of this group act by reducing blood sugar (in a communication that was apparently also overlooked by Wingfield). Napier and Sen (*loc. cit.*) were unable to show that diamidino stilbene had any hypoglycæmic properties in a case in which the blood sugar estimations were done, and recently we have confirmed this observation in two additional cases; the results are shown in the table:—

TABLE IX  
Effect on the blood sugar

|                           |                                 | BLOOD SUGAR ESTIMATIONS ON DIFFERENT DAYS |         |         |         |         |
|---------------------------|---------------------------------|---|---------|---------|---------|---------|
|                           |                                 | Grammes per cent                          |         |         |         |         |
|                           |                                 | 13-2-42                                   | 17-2-42 | 18-2-42 | 19-2-42 | 20-2-42 |
|                           | Date                            |   |         |         |         |         |
|                           | Amount of drug given at 10 a.m. | <i>nil</i> *                              | 0.025   | 0.050   | 0.075   | 0.090   |
| Case a.<br>Weight 88½ lb. | Before injection 10 a.m. ..     | 0.096                                     | 0.096   | 0.097   | 0.098   | 0.099   |
|                           | ½ hour after 10-30 a.m. ..      | 0.096                                     | 0.095   | 0.096   | 0.096   | 0.097   |
|                           | 1 hour after 11 a.m. ..         | 0.093                                     | 0.097   | 0.098   | 0.095   | 0.097   |
|                           | 1½ hour after 11-30 a.m. ..     | 0.095                                     | 0.096   | 0.097   | 0.098   | 0.096   |
| Case b.<br>Weight 93½ lb. | Before injection 10 a.m. ..     | ..  | 0.108   | 0.108   | 0.110   | 0.110   |
|                           | ½ hour after 10-30 a.m. ..      | ..  | 0.106   | 0.107   | 0.106   | 0.107   |
|                           | 1 hour after 11 a.m. ..         | ..  | 0.108   | 0.108   | 0.106   | 0.106   |
|                           | 1½ hour after 11-30 a.m. ..     | ..  | 0.108   | 0.106   | 0.107   | 0.108   |

\* Control taken at same hours of day.

In this same paper, Wingfield suggests that the reactions can be obviated if the injections are given slowly. We realized the importance of giving injections slowly from an early date in our experience, but it is not the complete answer, nor even the main factor. Also there is possibly another side to this. In our last two cases, we gave the injections even more slowly than before, taking about 5 minutes to complete the injection. In one case, three veins and, in the other, one became thrombosed. This may be a coincidence, but it is a complication we had not noted before. One is reminded of the recommendation that certain arsenicals—mapharside in particular—should be given rapidly to prevent local pain and thrombosis.

On a preliminary report from the pharmacologists that the fall of blood pressure was partly vagal in origin, we tried the prior administration of atropine to control the reactions, but after a few trials we abandoned this method.

In the majority of cases, the establishment of tolerance by increasing the size of the doses very slowly seemed to us the only certain way of obviating the reactions, but even this was not certain, *vide* case 52 in which the reactions seemed to increase in intensity. Further, this procedure will prolong the course of treatment

very considerably. Again, the worst reactions occurred in cases in which a comparatively small dose was given, whereas others have been given an initial dose relatively twice as great without any ill effects, so that it is obvious that the personal factor is an important one. We have noted that the worst cases, from the point of view of general condition, appear to stand the injections best.

We were compelled to turn again to adrenalin, but meanwhile we had found by experience that a very small dose was sufficient and that it was best to give it just before the other

injections. We eventually adopted this procedure of giving a very small dose (0.025 g.) of diamidino stilbene for the first one, to test the patient's susceptibility, then increasing the doses fairly rapidly, giving 0.25 c.cm. of 1 in 1,000 adrenalin *before* the injection, in those cases in which there was any sensitivity to the first dose. Later, when tolerance was established, it was usually possible to dispense with the adrenalin.

#### Neurological sequel

In a previous paper, we (Napier and Sen Gupta, *loc. cit.*) reported certain interesting neurological symptoms that occurred in 4 cases. In postscript, we referred to 3 more that had come to our notice, and now we have information regarding 2 more, making 9 such cases in all.

The salient features of the above cases are: (1) Subjective disturbance of sensation over various parts of the trigeminal area, paræsthesia, anæsthesia, formication, and hyperæsthesia. (2) Loss of sensation of light touch over this area, with the preservation of sense of pressure and pain (dissociated anæsthesia). (3) No evidence of other neurological or any systemic disorder.

#### RESULTS OF TREATMENT

In two of the first few cases treated (cases 4 and 16), the progress was slow and a second

course was given, possibly rather prematurely; otherwise, with one other exception, a single course only was given.

*Clinical response.*—In this series the fever usually continued until after the last injection (figures 2 and 3). If the patient was in an afebrile

Fig. 2. Case 82.

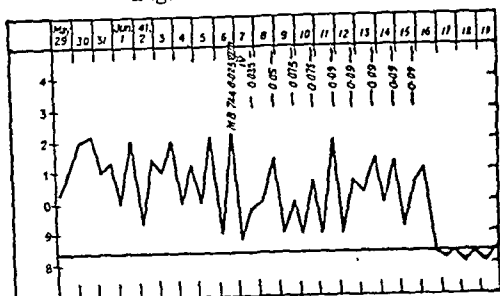
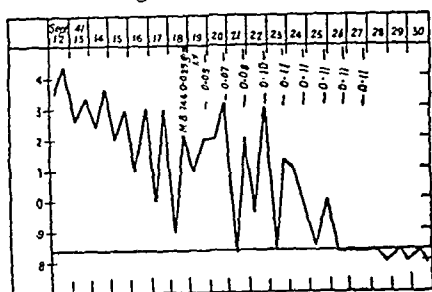
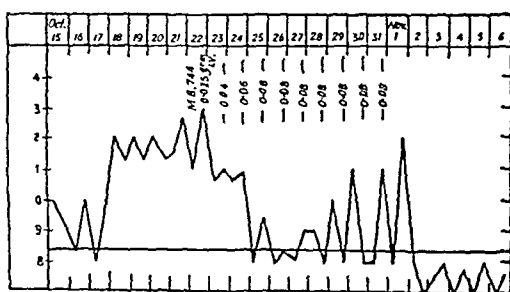


Fig. 3. Case 62.



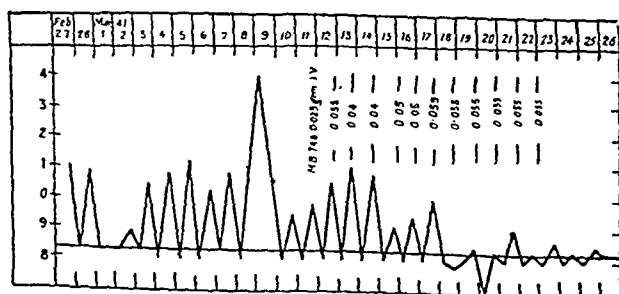
phase, or if the temperature fell early, it usually rose again after a few injections and was maintained as before until after the last injection (figure 4). Occasionally, it fell half-

Fig. 4. Case 87.



way through the course and remained normal (figure 5). At the end of the injections, the

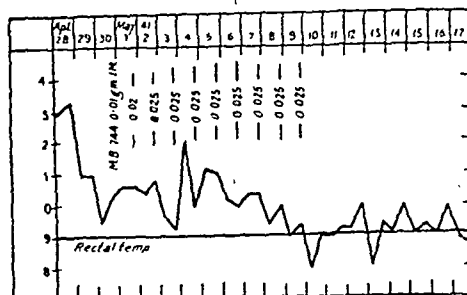
Fig. 5. Case 78.



leucocyte count was usually distinctly increased, but the weight often showed a decrease and the spleen usually remained about the same.

*Immediate cure rate.*—Two patients died and 99 were discharged as cured. Of the latter, two returned and were shown to have relapsed. One of the relapsing patients was again treated by diamidino stilbene and was discharged again apparently cured; the second case did not return until after the supply of the drug was exhausted, and he was treated on this occasion with neostibosan.

Fig. 6. Case 34.



*Deaths.*—Further details are given about the two patients who died:—

*Case 65.*—The patient had been suffering from kala-azar for 2 years before she came to the hospital. She was in a miserable state, seriously anæmic with œdema all over, heart enlarged and rapid in rate. She was given diamidino stilbene intramuscularly. From the day of the third injection she developed severe dysentery and also a few purpuric patches over the body. She did not respond to treatment for dysentery and purpura, and died the next day.

*Case 84.*—The patient had been suffering from kala-azar for 3 months before admission. He had 5 injections of urea stibamine 2 months before and developed jaundice one month before admission. On admission he had severe jaundice, and purpuric hæmorrhages under the skin and dysentery. He was given 9 injections, total dose amounting to 0.625 gm. There was no improvement in the diarrhoea or in the fever. Three days after the course he complained of severe pains in the left inguinal region. He also had slight ascites. The next day he developed a big subcutaneous hæmorrhagic patch extending over almost the whole of the left side of the abdominal wall and he also had severe hæmorrhage from the gums, hæmatemesis, and melæna. Hæmostatics and vitamins K and C were given without success. He died the same day.

It will be seen that there were few points of similarity between these two cases and that none of the symptoms which developed were obviously associated with the drug. Nor are there any obvious links between the severe symptoms that appeared in many cases and the symptoms in these cases. They were both apparently severe cases of kala-azar that one encounters from time to time.

In one case death occurred early in, but not at the beginning of, treatment, and in the other some days after treatment was completed. In the latter case, the dosage—individual, total, and relative—was well below the average, and neither patient showed anything but mild symptoms during the administration of the drug. The white cell counts in both were very low, 2,100 and 1,150 per c.mm., but in one-third of the cured cases the leucocyte count was as low as the higher of these two.

*Final results of treatment.*—If a relapse is going to occur, there is usually definite evidence of it within 4 months, and very rarely later than 6 months. In this series we have not had time to get into touch with all our patients, even if this were possible—for many live in villages many miles away—but we have either seen or

procedure was tried as an experiment. The injections were started two days after the last injection of neostibosan. The patient had a rather severe reaction with faintness and a feeble pulse from the fourth injection onwards. The dosage was reduced but he had to be given adrenalin after the seventh injection and again before the eighth injection. Details of the reactions to the injections are given below :—

| Date    | Dose in gm. | SYSTOLIC B.P. |       |            | DIASTOLIC B.P. |       |            | Reaction  |
|---------|-------------|---------------|-------|------------|----------------|-------|------------|---|
|         |             | Before        | After | Difference | Before         | After | Difference |   |
| 30-7-41 | 0.025       | 116           | 84    | — 32       | 84             | 50    | — 34       | Slight burning sensation.   |
| 31-7-41 | 0.040       | 100           | 84    | — 16       | 68             | 58    | — 10       | „ „ „   |
| 2-8-41  | 0.040       | 100           | 70    | — 30       | 70             | 40    | — 30       | „ „ „   |
| 3-8-41  | 0.050       | 94            | 52    | — 42       | 62             | 36    | — 26       | Faintness.  |
| 4-8-41  | 0.060       | ..            | ..    | ..         | ..             | ..    | ..         | Severe reaction, faintness, feeble pulse. Adrenalin 0.5 c.c. given with relief. |
| 5-8-41  | 0.070       | ..            | ..    | ..         | ..             | ..    | ..         | Ditto.  |
| 6-8-41  | 0.050       | 100           | 50    | — 50       | 72             | 30    | — 42       | Ditto.  |
| 7-8-41  | 0.050       | 92            | 100   | + 8        | 50             | 64    | + 14       | Adrenalin 0.5 c.cm. given before injection of diamidino stilbene. No reaction.  |

received a clear statement as to the present condition of 35 patients. Of these 2 have relapsed and the remaining 33 are apparently completely cured. Of the relapsing patients, one, a very resistant case, came again to see us on account of fever, and the other reported a return of symptoms by post and was readmitted at our request.

We have found in the past that a very large percentage of our patients return for treatment if they have relapsed, so it is probable that the vast majority of the rest were completely cured.

*Relapses.*—Short case notes are given on the two patients in which a relapse occurred :—

*Case 28.*—The patient had been suffering from kala-azar for 1½ years. She was very anæmic and emaciated and the spleen was enlarged 5½ inches below the costal margin. She had been treated with injections of neostibosan and urea stibamine and altogether 21 injections had been given without any marked effect on the disease. She was given a course of 15 injections of diamidino stilbene—total dose, 0.340 gm.; relative dose, 1.28 gm.—and was discharged apparently cured, the spleen measuring 1½ inches and the blood condition distinctly improved.

She had a relapse of fever 1½ months after discharge from the hospital and was readmitted. She was given two courses of injections of diamidino stilbene, 15 injections in the first and 12 injections in the second course, total dosage being 0.615 gm. She improved progressively and was afebrile for over 2 months before she was discharged, again apparently cured. The total dose for the three courses of injections was 0.955 gm.

*Case 52.*—The patient had been suffering from kala-azar one year before admission. He had no treatment before admission. He was given 3 injections of neostibosan—0.2, 0.3, and 0.3 gramme—on consecutive days, as in another case in which recent treatment with antimony had been given the temperature had come down quickly and this new modification of

It was decided to stop the injection at this stage, though he had only received an actual total dose of 0.385 gm. and a relative total dose of 0.40 gm., because of the reactions and the fact that he had had 3 injections of neostibosan too. Ten days after completion of treatment, he had an attack of dengue lasting for 5 days.

He was discharged apparently well on the way to recovery—spleen markedly reduced in size; he had been afebrile for about a month (barring 5 days of dengue), the hæmoglobin was 13 gm. per cent and the leucocyte count 3,250 per c.mm. He had a relapse after 3 months, with irregular attacks of fever, each lasting 8 to 10 days with enlargement of spleen and liver. He was readmitted, and the relapse was confirmed by a spleen puncture. He was treated with neostibosan (3.3 gm.), and discharged apparently cured, the spleen having receded to the level of the costal margin; the leucocyte count was 4,150 per c.mm. and the hæmoglobin 13.75 gm. per cent.

The first case (case 28) seems to be a truly 'resistant' case, also resistant to this treatment, as it proved to the previous antimony treatment. The relative dose received was well above the average. In the second case (case 52) the amount of treatment was far below the average, both as regards actual and relative total dosage, and in the case of the latter lower than that of any of the cured cases. It is therefore not surprising that a relapse occurred. When he relapsed, he responded well to a course of neostibosan, though we thought it advisable to continue the course to 12 injections; total dose 3.3 grammes.

In regard to the reactions to the drug in this case, the patient was unusual in that he did not develop any tolerance; in fact, the reactions became more severe, necessitating adrenalin, and we were thus encouraged to discontinue the treatment early, too early as it turned out.

*Clinical and blood picture improvement at time of discharge*

*Weight.*—In 96 cases the weight on admission and at the time of discharge was recorded:—

| Weight                           | Number of cases |
|----------------------------------|-----------------|
| Increase by—                     |                 |
| 7 lb. or less .. .. .            | 44              |
| Between 7 and 14 lb. .. .. .     | 28              |
| Between 14 and 21 lb. .. .. .    | 13              |
| Over 21 lb. .. .. .              | 2               |
|                                  | 87              |
| Weight remained the same .. .. . | 3               |
| Weight reduced .. .. .           | 6               |
|                                  | 96              |

In some cases the weight dropped as much as 13 lb. (e.g., case 2), as a result of fluid redistribution, before it began to rise again, so that, if the patient was discharged early, little or no increase in weight was apparent. In the 6 cases in which there was a decrease in weight this was apparently what happened, as 4 of them were known to be well 4 months after discharge. Both relapsing cases, on the other hand, showed an increase in weight.

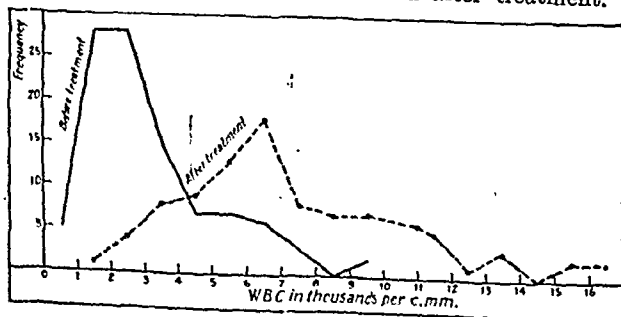
*Size of the spleen.*—The large majority of spleens were from 3 to 6 inches below the costal margin on admission. On discharge these were as follows:—

| Spleen   | Number of cases |
|--|-----------------|
| Not below the costal margin .. .. .                              | 41              |
| Palpable, or replaceable .. .. .                                 | 16              |
| Palpable but less than 3 inches below the costal margin. .. .. . | 40              |
| Between 3 and 6 inches below the costal margin. .. .. .          | 2               |
| Over 6 inches below the costal margin .. .. .                    | 2               |

The correlation between the size of the spleen and cure is not complete; for example, of the 4 cases in which the spleen was still over 3 inches below the costal margin, three were known to have been well four months after the course was complete and the fourth patient has not reported sick again. On the other hand, in both the relapsing cases the spleen was markedly reduced.

*The white cell count.*—The counts at the time of discharge are shown in table V, also graphic-

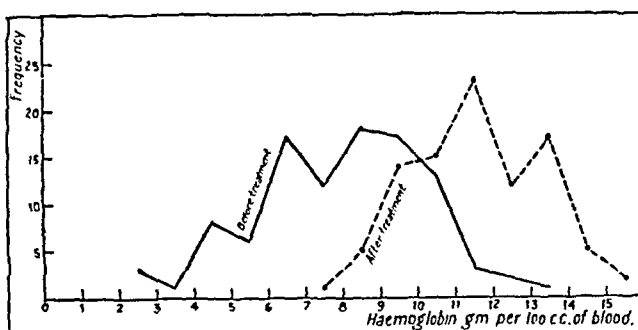
Fig. 7.—Leucocyte count before and after treatment.



ally in figure 7. It will be seen that in only 13 patients was the count below 4,000 per c.mm.; of these, in 9 the count had been very low at the beginning and had more than doubled at the time the final count was taken; the remaining 4 cases consisted of one patient who relapsed, one was discharged immediately after treatment and has subsequently been reported to be progressing well, and the other two otherwise did well and are believed to have been cured. In the other relapsing case the leucocyte count increased from 3,750 to 5,500 per c.mm.

*Hæmoglobin percentage.*—The final hæmoglobin percentage is shown in table III also graphically in figure 8. The mean of the

Fig. 8.—Hæmoglobin gm. per 100 c.cm. of blood before and after treatment.



counts is  $12.00 \pm 1.76$  grammes per 100 c.mm. of blood. This amounts to an all-round increase of 50 per cent on the counts before treatment. Some counts were still low but none were below 7 grammes whereas 35 were below this figure on admission. The two relapsing cases had final hæmoglobin percentages just above and just below the mean respectively.

### Discussion

*Criteria of cure.*—There appears to be no immediate criterion of cure in this disease and time alone will indicate if an apparent cure is a complete cure. The subject has frequently been discussed by the senior writer in the past (Napier, 1926-32 and Napier *et al.*, 1937). It was found that parasitological evidence is no more reliable than clinical. In a large percentage of the cases reported in this series a sternal puncture was done before discharge; in every case a negative result was obtained, though in two cases a relapse occurred later.

We have on past experience adopted as a rough guide for indicating cure that within a few days of the completion of treatment (a) the temperature should be normal and remain normal; (b) the white cell count should show a distinct increase; and that within two weeks of the completion of treatment (c) the patient's weight should have begun to increase, and (d) the spleen should show an appreciable decrease. It will probably be some further weeks before the leucocyte count has reached to a point within the normal range, the weight has returned to normal and the spleen has receded below the costal margin.

It will be seen that some of our cases did not fulfil these criteria, but yet were cured; on the other hand, one of the relapsing cases did fulfil them all and the other most of them.

We have found that about 95 per cent of cases that are going to relapse will do so within 4 months and practically all within 6 months. So we accept a case as finally cured if the patient is well and without symptoms at the end of six months.

A number of these patients fulfilled this requirement. The two relapsing patients returned for treatment after 1½ and 3 months, respectively. Amongst those about which we have no information, there is every reason to believe that they would have returned for further treatment had they relapsed; a large percentage of the patients do.

*The value of 4:4'-diamidino stilbene compared with other drugs.*—There is little object in comparing this drug with anything but the best drug hitherto used. This, in the writers' opinion, is neostibosan. The results of treatment with this drug in 254 cases were reported by the senior writer (Napier, 1932).

Neostibosan (di-ethyl-amine para-amino-phenyl stibiate) has been the main routine treatment for kala-azar in this institution since that date, and though records have not been analysed the writers are convinced that there has been a steady deterioration in the results

obtained during the last ten years. The drug is a definite compound and has, we believe, not undergone any change; our method of giving it is also unchanged, except that in recent years we have had so many relapses with the smaller total doses that we now give 12 injections as a routine. This 'resistance' is also in evidence when other antimony compounds are used.

We know that kala-azar as it occurs in the Sudan is far more resistant to any form of antimony treatment than is the disease as we see it here. There is no reason to believe that there has been any naturally resistant strain introduced into Bengal and Assam, but it does seem possible that as kala-azar has been treated very widely in these provinces with antimony compounds for over 20 years now, the local strains are acquiring a degree of antimony resistance.

It was out of the question to run a parallel series of cases treated with neostibosan and diamidino stilbene. Also perhaps it is fairer to compare the earlier and better results that we obtained with neostibosan than the present-day results; certainly it will be a severer test for the new drug.

We have extracted certain data from the paper referred to above (Napier, 1932) and have taken more-or-less parallel results from this present paper. These are shown side by side in a tabular statement below:—

TABLE X  
*Comparing diamidino stilbene and neostibosan*

|  | Di-ethyl-amine<br>para-amino-phenyl<br>stibiate | Percentage<br>cured | Diamidino<br>stilbene | Percentage<br>cured |
|--|---|---------------------|-----------------------|---------------------|
| <i>Immediate results—</i>                                  |   |                     |                       |                     |
| Discharged cured .. ..                                     | 244   | 96.10               | 99                    | 98.02               |
| Failed to respond to treatment .. ..                       | 4   | ..                  | 0                     | ..                  |
| Died during treatment .. ..                                | 6   | ..                  | 2                     | ..                  |
|  | 254   | ..                  | 101                   | ..                  |
| <i>Subsequent history—</i>                                 |   |                     |                       |                     |
| Cured .. ..  | 199   | 91.28               | 33                    | 94.29               |
| Died within six months of some other<br>disease (?). .. .. | 6   | ..                  | 0                     | ..                  |
| Relapsed .. ..   | 13  | ..                  | 2                     | ..                  |
|  | 218   | ..                  | 35                    | ..                  |
| <i>Excluding 'resistant' cases—</i>                        |   |                     |                       |                     |
| Cured .. ..  | 181   | 92.35               | 23                    | 95.83               |
| Died .. ..   | 5   | ..                  | 0                     | ..                  |
| Relapsed .. ..   | 10  | ..                  | 1                     | ..                  |
|  | 196   | ..                  | 24                    | ..                  |
| <i>Excluding also short-treatment cases—</i>               |   |                     |                       |                     |
| Cured .. ..  | 163   | 93.14               | 23                    | 100.00              |
| Died or relapsed .. ..                                     | 12  | ..                  | 0                     | ..                  |
|  | 175   | ..                  | 23                    | ..                  |

A glance at this table will show that the results with diamidino stilbene compare very favourably with those obtained with neostibosan, whichever way the results are analysed, though the differences in the percentages are not significant statistically.

It should be noted that in no previously untreated cases in which our arbitrarily adopted 'full course' was given was there a relapse.

*Resistant cases.*—In the 25 resistant cases the results were extremely satisfactory as the total dose given was very little higher than in the ordinary cases, and, excluding the one patient who died, the immediate cure rate was 95.83 per cent and final cure rate 90.90 per cent; only one in 11 cases, whose subsequent history was known, relapsing.

The following table shows the previous treatment that they had had and the result of the current treatment :—

TABLE XI  
Summary of resistant cases

| Case number | PREVIOUS TREATMENT              |   |  | DIAMIDINO STILBENE           |           |
|-------------|---------------------------------|---|--|------------------------------|-----------|
|             | Previous drug given             | Amount                                  | Result   | Total dosage                 | Result    |
| 4           | Pentavalent antimonials ..      | ..                                      | Little improvement                                   | 0.850 + 0.915<br>= 1.765 gm. | C.        |
| 15          | Urea stibol .. ..               | 3 gm.                                   | Do.  | 1.15 gm.                     | C.        |
|             | Urea-stibamine .. ..            | 2 gm.                                   |  |                              |           |
| 16          | Neostibosan .. ..               | 16 injections                           | Do.  | 0.140 + 0.243<br>= 0.383 gm. | C.        |
| 18          | Solustibosan .. ..              | 5 injections                            | Do.  | 0.275 gm.                    | C.        |
|             | Neostibosan .. ..               | 5 injections at least.                  |  |                              |           |
| 24          | Neostibosan .. ..               | 1 full course                           | Do.  | 1.57 gm.                     | C.        |
| 28          | Neostibosan and urea-stibamine. | Total 21 injections.                    | Do.  | 0.340 gm.                    | Relapsed. |
| 92          | Diamidino stilbene ..           | 0.340 gm.                               | Relapse after 1½ months                              | 0.315 + 0.305<br>= 0.620 gm. | C.        |
| 34          | Urea-stibamine .. ..            | 2 injections                            | Little improvement                                   | 0.230 gm.                    | C.        |
|             | Neostibosan .. ..               | 4 injections                            |  |                              |           |
| 36          | Urea-stibamine .. ..            | 12 injections                           | Relief followed by relapse.                          | 1.23 gm.                     | C.        |
|             | Do. .. ..                       | 16 injections                           | Do.  |                              |           |
|             | Neostibosan .. ..               | 4 injections                            | Little improvement                                   | 0.82 gm.                     | C.        |
|             | Solustibosan .. ..              | 8 injections                            |  |                              |           |
| 44          | Urea-stibamine .. ..            | 15 injections                           | Relief with relapse after 1 year.                    | 0.37 gm.                     | C.        |
|             | Do. .. ..                       | 15 injections                           | Little improvement                                   |                              |           |
| 51          | Pentavalent antimonials ..      | 40 injections                           | Relief followed by relapse after 1 month.            | 1.05 gm.                     | C.        |
| 55          | Aminostiburea .. ..             | 2.7 gm.                                 | Relief followed by relapse.                          | 1.25 gm.                     | C.        |
| 58          | Neostibosan .. ..               | 2.3 gm.                                 | Little improvement                                   | 0.96 gm.                     | C.        |
|             | Do. .. ..                       | 2.0 gm.                                 | Relief followed by relapse.                          |                              |           |
| 66          | Do. .. ..                       | 36 injections                           | Little improvement                                   | 1.36 gm.                     | C.        |
|             | Novostiburea .. ..              | 4 injections                            | Relapse after a month                                |                              |           |
| 69          | Neostibosan .. ..               | 1 course of injection.                  | Little improvement                                   | 1.115 gm.                    | C.        |
|             | Antimonial (pentavalent ?)      | 5 injections                            | Do.  |                              |           |
| 72          | Do. do. .. ..                   | 7 injections                            | Do.  | 0.98 gm.                     | C.        |
| 73          | Do. do. .. ..                   | 25 injections                           | Do.  | 0.66 gm.                     | C.        |
| 75          | Do. do. .. ..                   | 9 injections                            | Do.  | 0.775 gm.                    | C.        |
| 78          | Neostibosan .. ..               | 4 gm. in several courses of injections. | Do.  | 0.570 gm.                    | C.        |
| 84          | Urea-stibamine .. ..            | 5 injections                            | Persistence of fever. Jaundice developed soon after. | 0.625 gm.                    | Died.     |
| 85          | Neostibosan .. ..               | 13 injections, 2.7 gm.                  | Relief followed by relapse.                          | 0.730 gm.                    | C.        |
| 88          | Urea-stibamine .. ..            | 1 course                                | Do.  | 1.015 gm.                    | C.        |
|             | Neostibosan .. ..               | 1 course                                | Little improvement                                   | ..                           | ..        |
|             | Urea-stibamine .. ..            | 21 injections                           |  |                              |           |
| 91          | Antimonials (pentavalent ?)     | 15 injections                           | Do.  | 0.780 gm.                    | C.        |
| 98          | Neostibene .. ..                | 18 injections in all                    | Relief followed by relapse.                          | 1.25 gm.                     | C.        |
|             | Urea-stibamine .. ..            |   |  |                              |           |
|             | Neostibosan .. ..               | 10 injections                           | Little improvement                                   | ..                           | ..        |
|             | Neostibosan .. ..               |   |  |                              |           |





I—contd.

| 57    | 58R   | 59            | 60    | 61    | 62    | 63    | 64    | 65    | 66R   | 67    | 68    | 69R   |
|-------|-------|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Ind.  | Ind.  | Ind.          | Ind.  | Ind.  | Ind.  | Ind.  | Ind.  | Ind.  | Ind.  | Ind.  | A.-I. | A.-I. |
| 2     | 35    | 25            | 18    | 17    | 30    | 30    | 12    | 9     | 38    | 23    | 14    | 26    |
| M.    | M.    | M.            | M.    | M.    | M.    | M.    | M.    | F.    | M.    | M.    | F.    | M.    |
| 22    | 113   | 85            | 79    | 89    | 110   | 100   | 42    | 46    | 119   | 69    | 86    | 111   |
| 5     | 8     | 15/30         | (48)  | 8     | 3     | 6     | (36)  | (24)  | 7     | 12    | (2/3) | (5)   |
| 2     | 8     | 2             | 8     | 4     | 2     | 5     | 4     | 1     | 9     | 3     | 6     | 6     |
| ±     | ++    | +             | +++   | +++   | ±     | +++   | +++   | +     | +++   | ++    | ++    | ++    |
| 6.8   | 8.11  | 13.31         | 6.87  | 10.72 | 8.2   | 9.76  | 7.56  | 2.61  | 6.46  | 6.18  | 11.0  | 6.325 |
| 93.7  | 96.6  | 89.4          | 98.1  | 98.4  | 82.11 | 90.33 | 101.6 | 118.0 | 103.2 | 92.2  | 88.5  | 104.2 |
| 3.4   | 1.7   | 3.6           | 2.4   | 1.6   | 1.5   | 1.2   | 3.1   | 2.1   | 2.6   | 1.6   | 6.3   | 1.15  |
| N.D.  | N.D.  | N.D.          | N.D.  | N.D.  | +     | N.D.  | N.D.  | N.D.  | N.D.  | N.D.  | N.D.  | N.D.  |
| +     | +     | +             | +     | +     | N.D.  | +     | +     | +     | +     | +     | +     | +     |
| 0.27  | 1.250 | 0.575         | 0.685 | 0.665 | 0.875 | 0.815 | 0.445 | 0.14  | 0.96  | 0.635 | 0.61  | 1.36  |
| I.M.  |       |               |       |       |       |       |       |       |       |       |       |       |
| 1.227 | 1.101 | 0.674         | 0.867 | 0.743 | 0.791 | 0.815 | 1.059 | 0.301 | 0.803 | 0.917 | 0.705 | 1.225 |
| 0.03  | 0.11  | 0.08          | 0.08  | 0.09  | 0.11  | 0.1   | 0.05  | 0.05  | 0.12  | 0.07  | 0.08  | 0.11  |
| 10    | 15    | 10            | 10    | 10    | 10    | 10    | 10    | 4     | 10    | 10    | 10    | 15    |
| +     | —     | 1st 5 inj.    | —     | —     | —     | +     | —     | —     | —     | —     | —     | +     |
| —     | —     | + last 5 inj. | —     | —     | —     | 0     | +     | —     | —     | —     | —     | —     |
| N.D.  | N.D.  | N.D.          | N.D.  | Neg.  | N.D.  | N.D.  | N.D.  | N.D.  | Neg.  | N.D.  | N.D.  | N.D.  |
| 10.03 | 14.43 | 14.16         | 10.31 | 12.37 | 14.8  | 11.96 | ..    | ..    | 11.5  | 8.8   | 12.37 | 8.662 |
| 10.0  | 5.6   | 7.9           | 7.0   | 6.7   | 7.7   | 5.6   | ..    | ..    | ..    | 4.6   | 5.8   | 2.4   |
| O.    | 7     | O.            | 2     | 6½    | O.    | 1½    | ..    | ..    | 2     | 1     | P.    | 2½    |
| 25    | 114   | 98            | 87    | 88    | 118   | 101   | ..    | ..    | 136   | 84    | 93    | 109   |
| C.    | C.    | C.            | C.    | C.    | C.    | C.    | ..    | Died  | C.    | C.    | C.    | C.    |
| C.    | C.N.  | C.N.          | ..    | ..    | C.    | C.    | ..    | ..    | C.    | ..    | ..    | C.N.  |

I—contd.

| 79     | 80      | 81    | 82     | 83    | 84R   | 85R   | 86     | 87      | 88R   | 89     | 90    | 91R   |
|--------|---------|-------|--------|-------|-------|-------|--------|---------|-------|--------|-------|-------|
| A.-I.  | Ind.    | Ind.  | Ind.   | Ind.  | A.-I. | Ind.  | Ind.   | Ind.    | Ind.  | Ind.   | Ind.  | Ind.  |
| 12     | 34      | 36    | 25     | 15    | 32    | 13    | 10     | 40      | 41    | 20     | 25    | 28    |
| F.     | M.      | M.    | M.     | F.    | M.    | M.    | F.     | M.      | M.    | M.     | M.    | M.    |
| 47     | 118     | 81    | 83     | 76    | 82    | 70    | 52     | 82      | 116   | 76     | 101   | 116   |
| 4      | 7 years | 20/30 | 18     | 8     | 3     | 7     | 12     | 30      | 17    | 12     | 4     | 30    |
| 4      | 5½      | 1½    | 5      | 2     | 3     | 4     | 6      | 1       | 6     | 6½     | 5½    | 6     |
| +      | +       | Neg.  | +++    | ++    | Neg.  | +     | +++    | +++     | ++    | +++    | ++    | +++   |
| 9.07   | 9.9     | 8.25  | 6.325  | 9.48  | 10.31 | 5.63  | 6.73   | 6.18    | 8.66  | 10.725 | 6.6   | 6.46  |
| 74.2   | 94.8    | 100.0 | 87.9   | 88.2  | 75.6  | 88.8  | 100.0  | 86.9    | 98.3  | 94.11  | 81.5  | 108.3 |
| 2.1    | 1.35    | 0.65  | 1.1    | 2.6   | 1.15  | 1.8   | 1.45   | 3.35    | 2.55  | 4.7    | 1.5   | 0.9   |
| N.D.   | +       | N.D.  | N.D.   | N.D.  | N.D.  | +     | N.D.   | N.D.    | +     | C. +   | N.D.  | +     |
| +      | Neg.    | +     | +      | +     | +     | N.D.  | +      | +       | N.D.  | Neg.   | +     | Neg.  |
| 0.345  | 1.535   | 0.780 | 0.710  | 0.695 | 0.625 | 0.730 | 0.465  | 0.685   | 1.015 | 0.625  | 0.815 | 0.780 |
| 0.734  | 1.298   | 0.960 | 0.844  | 0.911 | 0.762 | 1.042 | 0.881  | 0.830   | 0.873 | 0.822  | 0.802 | 0.669 |
| 0.05   | 0.12    | 0.09  | 0.09   | 0.08  | 0.08  | 0.07  | 0.05   | 0.08    | 0.11  | 0.07   | 0.10  | 0.11  |
| 10     | 15      | 10    | 10     | 10    | 9     | 12    | 10     | 10      | 12    | 10     | 10    | 10    |
| +      | +       | +     | +      | +     | +     | +     | +      | +       | +     | +      | Nil   | +     |
| —      | —       | —     | —      | —     | —     | —     | —      | —       | —     | —      | —     | —     |
| Neg.   | Neg.    | Neg.  | ..     | ..    | ..    | ..    | ..     | ..      | ..    | ..     | ..    | ..    |
| 27     | 18      | 20    | ..     | ..    | ..    | ..    | ..     | ..      | ..    | ..     | ..    | ..    |
| 11.687 | 14.02   | 11.6  | 10.312 | 10.86 | 9.62  | 8.93  | 11.687 | (7.562) | 12.65 | 11.0   | ..    | 10.31 |
| 7.3    | 4.55    | 2.2   | 3.95   | 6.35  | 3.4   | 7.4   | 5.2    | 5.0     | 6.4   | 11.30  | ..    | 4.15  |
| P.     | P.      | O.    | 2      | O.    | ..    | 2½    | 2½     | O.      | P.    | ..     | ..    | 3     |
| 59     | 123     | 87    | 95     | 81    | ..    | 66    | 57     | 97      | 113   | 87     | 106   | 116   |
| C.     | C.      | C.    | C.     | C.    | D.    | C.    | C.     | C.      | C.    | C.     | C.    | C.    |
| ..     | C.N.    | ..    | ..     | ..    | ..    | C.    | ..     | ..      | ..    | C.N.   | ..    | ..    |

## PROTOCOL I—concl'd.

| Serial number ..                    | 92R   | 93    | 94    | 95     | 96    | 97    | 98R   | 99    | 100    | 101   |
|-------------------------------------|-------|-------|-------|--------|-------|-------|-------|-------|--------|-------|
| Race ..                             | Ind.  | Ind.  | Ind.  | Ind.   | Ind.  | Ind.  | A.-I. | Ind.  | Ind.   | Ind.  |
| Age in years ..                     | 7     | 20    | 41    | 15     | 10    | 1     | 23    | 4     | 19     | 25    |
| Sex ..                              | F.    | M.    | F.    | M.     | M.    | F.    | M.    | M.    | M.     | M.    |
| Weight in pounds ..                 | 29    | 84    | 77    | 97     | 48    | 16    | 118   | 23    | 93     | 88    |
| Duration in months ..               | (24)  | 12    | 10    | ?      | 1     | (12)  | 7     | 5     | 4      | 15    |
| Spleen, inches below cost. marg.    | 5     | 4     | 3½    | ½      | 4     | 4     | 7     | 4½    | 3      | 6     |
| Aldehyde reaction ..                | ++    | +++   | +++   | +++    | (+)   | (±)   | (+)   | (+)   | ±      | ++    |
| Hæmoglobin gm. per 100 c.cm.        | 3.025 | 4.81  | 8.25  | 7.15   | 8.25  | 4.95  | 9.63  | 5.2   | 7.56   | 4.812 |
| Mean corpuscular volume (c.µ)       | 130.2 | 82.9  | 111.5 | 116.07 | 83.3  | ..    | 78.7  | 80.1  | 85.4   | 113.0 |
| Leucocytes per c.mm. in 10³ ..      | 2.3   | 2.8   | 5.45  | 4.4    | 4.2   | 4.0   | 2.5   | 6.6   | 0.85   | 2.1   |
| Diagnostic puncture—spleen ..       | +     | +     | N.D.  | N.D.   | N.D.  | +     | +     | +     | +      | N.D.  |
| sternum (or tibia) ..               | Neg.  | N.D.  | +     | +      | +     | N.D.  | Neg.  | N.D.  | N.D.   | +     |
| Total dose M.&B. 744, grammes       | 0.315 | 0.685 | 0.625 | 0.635  | 0.435 | 0.19  | 1.25  | 0.220 | 0.685  | 0.690 |
| Total dose per 100 pounds           | 0.305 | 0.813 | 0.803 | 0.652  | 0.901 | 1.187 | 1.059 | 0.936 | 0.732  | 0.779 |
| body-weight, g.                     | 0.953 | 0.03  | 0.08  | 0.09   | 0.05  | 0.02  | 0.10  | 0.025 | 0.09   | 0.09  |
| Maximum individual dose, g.         | 0.035 | 0.08  | 0.08  | 0.09   | 0.05  | 0.02  | 0.10  | 0.025 | 0.09   | 0.09  |
| Number of doses ..                  | 15/12 | 10    | 10    | 9      | 10    | 10    | 15    | 10    | 9      | 9     |
| Reaction, slight ..                 | +     | —     | —     | +      | +     | Nil   | +     | +     | +      | +     |
| Reaction, severe ..                 | —     | —     | +     | —      | —     | —     | —     | —     | —      | —     |
| Final sternum puncture ..           | ..    | ..    | ..    | ..     | ..    | ..    | Neg.  | ..    | ..     | ..    |
| No. of days after last injection .. | ..    | ..    | ..    | ..     | ..    | ..    | 31    | ..    | ..     | ..    |
| Final hæmoglobin, g.                | 9.62  | 9.12  | 11.13 | ..     | 9.07  | 11.68 | 13.75 | 12.23 | 12.375 | 11.68 |
| Final leucocyte count ..            | 4.0   | 3.5   | 6.25  | ..     | 6.6   | 16.2  | 6.5   | 6.7   | 3.05   | 4.75  |
| Final spleen, inches ..             | 2     | P.    | O.    | P.     | P.    | ½     | ½     | 1     | P.     | P.    |
| Final weight, lb. ..                | 35    | 97    | 77    | 102    | 53    | 18    | 123   | 31    | 96     | 91    |
| Immediate result ..                 | C.    | C.    | C.    | C.     | C.    | C.    | C.    | C.    | C.     | C.    |
| Subsequent history ..               | ..    | ..    | ..    | ..     | ..    | ..    | ..    | ..    | ..     | ..    |

R. = 'Resistant' case. E. = European. A.-I. = Anglo-Indian. Ind. = Indian. N.D. = Not done. P. = Just palpable. O. = Not palpable. Weight: Second weight is before treatment. Duration: Brackets indicate history questionable. Hæmoglobin: Brackets indicate counts during treatment. + p.b. = Leishmania present in peripheral blood. \* In final puncture = Spleen puncture. C. = Discharged as cured, or finally reported cured. N. = Developed neuropathy later. R. = Relapsed. M. & B. 744 = Diamidino stilbene.

### The treatment in other leishmanial infections

The drug has been used in four cases of oriental sore; the first two only had single injections as they were out-patients and did not return after the first severe reaction that they suffered. In the other cases a full course was given, but neither patient showed much improvement.

In two cases of post-kala-azar dermal leishmaniasis, a full course was given without any perceptible improvement in the dermal lesions being apparent.

### Summary

4 : 4'-diamidino stilbene has been used in the treatment of Indian kala-azar in 100 patients, of ages from under one year to over 45, mostly Indians, at all stages of the disease, in about half the disease being over 6 months' duration.

The diagnosis was confirmed in all but two typical cases by demonstrating the parasite by spleen, sternum, or tibia puncture, and if necessary culture of the material. Our findings indicated that spleen puncture was the most reliable method. The aldehyde test was positive in 74 out of 100 cases.

The mean hæmoglobin percentage was  $7.96 \pm 2.26$  grammes per 100 c.cm., the mean of the

mean corpuscular volume was  $94.1 \pm 15.2$  cu. µ, and the mean leucocyte count  $3.470 \pm 2.150$  thousands per c.cm.; in 33 cases the leucocyte count was below 2,000 and in 76 below 4,000 per c.mm.

The drug was given intravenously in a 1 per cent solution in distilled water, in all but 5 cases in which it was given intramuscularly. It was very painful by the latter route. Injections were given daily.

In over 90 per cent of the previously untreated cases, either 10 or 12 injections were given; in the 'resistant' cases, sometimes up to 15 injections were given.

The scheme of dosage for adults finally adopted was an initial dose of 0.025 g., followed by doses of 0.050, 0.060 to 0.075 according to the reaction, 0.090 and 0.100 gramme, up to a maximum of about 1 mgm. (0.001 g.) per pound weight of patient; for small children the initial dose was 0.010 g. up to a slightly higher dose than 1 mgm. per lb., as children stood the drug better.

The mean total dose given in ordinary cases was  $0.597 \pm 0.245$  g.; in 'resistant' cases it was  $0.884 \pm 0.414$  g.

## PROTOCOL II

|      | 1ST DOSE—0.025 GM. |       |            |           |       |            | 2ND DOSE—0.05 GM. |       |            |           |       |            | 3RD DOSE—0.075 GM. |       |            |           |       |            |
|------|--------------------|-------|------------|-----------|-------|------------|-------------------|-------|------------|-----------|-------|------------|--------------------|-------|------------|-----------|-------|------------|
|      | Systolic           |       |            | Diastolic |       |            | Systolic          |       |            | Diastolic |       |            | Systolic           |       |            | Diastolic |       |            |
|      | Before             | After | Difference | Before    | After | Difference | Before            | After | Difference | Before    | After | Difference | Before             | After | Difference | Before    | After | Difference |
| 1    | 110                | 96    | 14         | 70        | 56    | 14         | 118               | 100   | 18         | 78        | 60    | 18         | 126                | 84    | 42         | 82        | 30    | 52*        |
| 2    | 130                | 85    | 45         | 75        | 35    | 40         | 112               | 100   | 12         | 68        | 60    | 8          | 112                | 84    | 28         | 64        | 50    | 14         |
| 3    | 108                | 90    | 18         | 75        | 54    | 21         | 102               | 98    | 4          | 66        | 66    | 0          | 98                 | 92    | 6          | 72        | 70    | 2          |
| 4    | 94                 | 84    | 10         | 48        | 40    | 8          | 94                | 64    | 30         | 56        | 28    | 28         | 96                 | 90    | 6          | 50        | 40    | 10         |
| 5    | 90                 | 82    | 8          | 48        | 40    | 8          | 92                | 60    | 32         | 52        | 28    | 24         | 90                 | 76    | 14         | 50        | 40    | 10         |
| 6    | 94                 | 76    | 18         | 66        | 52    | 14         | 82                | 76    | 6          | 50        | 44    | 6          | 90                 | 76    | 14         | 56        | 42    | 14         |
| 7    | 116                | 84    | 32         | 84        | 50    | 34         | 100               | 84    | 16         | 68        | 58    | 10         | 100                | 70    | 30         | 70        | 40    | 30         |
| 8    | 122                | 100   | 22         | 80        | 65    | 15         | 108               | 94    | 14         | 76        | 52    | 24         | 110                | 90    | 20         | 70        | 60    | 10         |
| 9    | 125                | 100   | 25         | 80        | 65    | 15         | 124               | 104   | 20         | 80        | 70    | 10         | 120                | 104   | 16         | 88        | 66    | 22         |
| 10   | 106                | 76    | 30         | 76        | 48    | 28         | 104               | 86    | 18         | 84        | 40    | 44         | 115                | 90    | 25         | 70        | 60    | 10         |
| 11   | 120                | 94    | 26         | 66        | 46    | 20         | 112               | 102   | 10         | 68        | 50    | 18         | 110                | 80    | 30         | 70        | 40    | 30         |
| 12   | 94                 | 80    | 14         | 68        | 50    | 18         | 94                | 60    | 34         | 70        | 30    | 40         | 92                 | 60    | 32         | 62        | 30    | 32*        |
| 13   | 118                | 100   | 18         | 80        | 70    | 10         | 118               | 100   | 18         | 70        | 62    | 8          | 112                | 80    | 32         | 76        | 42    | 34*        |
| 14   | 110                | 96    | 14         | 68        | 50    | 18         | 102               | 100   | 2          | 64        | 56    | 8          | 100                | 90    | 10         | 66        | 54    | 12         |
| 15   | 110                | 105   | 5          | 66        | 60    | 6          | 98                | 88    | 10         | 62        | 50    | 12         | 94                 | 90    | 4          | 70        | 60    | 10         |
| 16   | 120                | 115   | 5          | 80        | 75    | 5          | 110               | 90    | 20         | 76        | 54    | 22         | 94                 | 80    | 14         | 70        | 45    | 25         |
| 17   | 106                | 98    | 8          | 70        | 56    | 14         | 110               | 98    | 12         | 70        | 68    | 2          | 112                | 70    | 42         | 70        | 30    | 40*        |
| 18   | 98                 | 98    | 0          | 70        | 70    | 0          | 102               | 94    | 8          | 66        | 58    | 8          | 94                 | 90    | 4          | 60        | 60    | 0          |
| 19   | 100                | 65    | 35         | 70        | 20    | 50         | 100               | 82    | 18         | 70        | 50    | 20         | 108                | 65    | 43         | 68        | 50    | 18         |
| 20   | 112                | 82    | 30         | 62        | 52    | 10         | 120               | 90    | 30         | 70        | 50    | 20         | 110                | 82    | 28         | 60        | 50    | 10         |
| 21   | 108                | 102   | 6          | 70        | 70    | 0          | 98                | 98    | 0          | 64        | 64    | 0          | 94                 | 76    | 18         | 64        | 44    | 20         |
| 22   | 100                | 90    | 10         | 70        | 58    | 12         | 110               | 102   | 8          | 68        | 65    | 3          | 110                | 90    | 20         | 65        | 50    | 15         |
| 23   | 112                | 102   | 10         | 80        | 70    | 10         | 96                | 88    | 8          | 65        | 65    | 0          | 104                | 60    | 44         | 68        | 20    | 48*        |
| 24   | 115                | 115   | 0          | 80        | 75    | 5          | 102               | 95    | 7          | 80        | 50    | 30         | 94                 | 68    | 26         | 60        | 40    | 20         |
| Mean | 109.08             | 92.29 | 16.79      | 70.91     | 53.21 | 15.62      | 104.91            | 89.71 | 14.79      | 68.37     | 53.25 | 15.12      | 103.5              | 81.04 | 22.83      | 66.7      | 46.8  | 20.33      |
| Sd.  |                    |       | 11.4       |           |       | 11.8       |                   |       | 9.2        |           |       | 12.01      |                    |       | 12.4       |           |       | 13.3       |

The mean total relative dose per 100 lb. weight of patient was  $0.912 \pm 0.224$  g.; in 'resistant' cases it was  $1.009 \pm 0.293$  g.

The reactions that occur are troublesome and sometimes alarming but apparently not dangerous. They are almost the rule, about a quarter of the patients had severe reactions, another half mild reactions, and even the other quarter were not entirely free from unpleasant sensations.

The blood pressure nearly always shows a marked drop after the injections; sometimes this is very alarming.

The best method of controlling the reactions is by injecting 0.25 c.cm. of 1 in 1,000 adrenalin intramuscularly just before the injection of diamidino stilbene.

The immediate result of treatment was that 98 patients were cured and two died. Subsequently, two of the patients relapsed and one was treated a second time with this drug.

The clinical and hæmatological improvement in the treated cases is analysed. In only 13 cases was the white cell count below 4,000 per c.mm., against 76 before treatment. The hæmoglobin had increased by 50 per cent on the pre-treatment readings.

The criteria of cure are discussed.

### Conclusions

With the introduction of 4 : 4'-diamidino stilbene a very great advance has been scored in the treatment of kala-azar.

The results of treatment with this drug in the ordinary case of Indian kala-azar compare very favourably with those produced by neostibosan, the best drug hitherto used.

The results obtained in the treatment in the antimony-resistant cases are almost as favourable as those in ordinary cases. This is a very important advance, as hitherto a considerable percentage of these patients have become discouraged after one or two relapses, and have returned to their homes to die.

Gramme for gramme diamidino stilbene appears to be at least four times as effective as neostibosan.

In an average mixed population, 60 grammes of diamidino stilbene should be sufficient to cure 100 patients and about 90 grammes to cure 100 patients of an average weight of 100 lb. each.

There is no evidence in our limited experience that the drug is of any value in the treatment of dermal and cutaneous leishmaniasis.

### Acknowledgment

Our thanks are due to Messrs. May & Baker for the generous supply of the drug with which

(Concluded on next page)

## FURTHER EXPERIENCES ON ENDEMIC TYPHUS IN MYSORE

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SINCE our first publication on this subject (Heilig and Naidu, 1941) was concluded, ten more cases of typhus have been observed here. As some facts have been found which made it easier to classify our 'Mysore typhus', in determining its rightful place on the chequered typhus map, these observations may be reported.

Fourteen cases of endemic typhus have been seen by us within sixteen months (November 1940 to end of February 1942). They showed a definite seasonal incidence: maximum in August with four cases; September, two; October to February one case per month; March to July no case.

**Geographically.**—Ten cases from Mysore City, four (cases 2, 3, 12, 13) from different large villages, situated at a distance of up to 40 miles from Mysore, within the city three patients (cases 5, 6, 7) who lived in two opposite houses

(Continued from previous page)

this trial has been carried out. The drug is now marketed under the name 'Stilbamidine'.

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and fell ill within one and the same week; in cases 1 and 10 and 11 and 14, respectively, the patients lived close to each other but each of these couples lived in different parts of the city. They fell ill at different times.

**Age incidence.**—Three to sixty years.

**Sex distribution.**—Six male adults, two boys, four female adults, two girls.

**Community.**—Twelve Hindus, two Mohammedans.

The clinical picture was so uniform in all these cases that further detailed case reports are not necessary. The onset was sudden, with malaise and a chilly feeling but invariably without a rigor, severe headache and in three cases pain all over the body, similar to those in dengue fever. Fever lasts for 16 to 21 days; the temperature is high from the beginning, usually remittent, between 100°F. in the morning and 102°F. to 104°F. in the late afternoon; at the end of the second week, it becomes intermittent and comes down to normal in a short lysis of two to three days' duration. No second rise was ever noticed when the temperature had once been normal for 24 hours. Figure 1 (case 11) shows a typical fever chart; figure 2 (case 14) one of a rare

Fig. 1. Case 11.

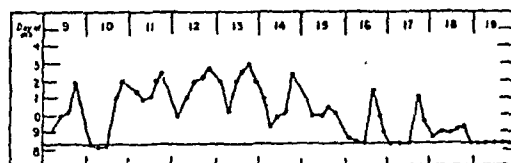
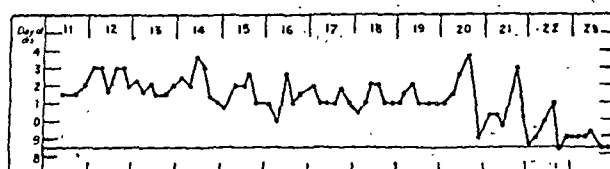


Fig. 2. Case 14.



type: continuous fever for 18 days, which became suddenly intermittent for three days and subsided from the twenty-second day. Pulse and respiration rate are increased according to the temperature; no relative bradycardia was noticed. Respiratory tract infections are conspicuously absent; even in the severest case, characterized by 'typhoid state' or in elderly people, neither bronchitis nor the slightest sign of lung consolidation was present. The tongue is moist and coated in the milder, dry and brownish furred in the severe cases. Conjunctivitis was present from the beginning in all, but one or two cases, persisting sometimes longer than the fever. It gives the eyes a blood-shot appearance and sometimes causes burning sensation and watering of the eyes. Liver and spleen are hardly enlarged. The general and mental condition is mostly satisfactory, though the patients do not feel too well on account of the fever and headache; only in case 3, a Mohammedan lady of 50 was for about five days in a 'typhoid state'. Convalescence



Fig. 3.



Fig. 4.

Case 10. 22nd day of disease. 15th day of rash.



Fig. 5. Case 11.  
17th day of disease. 8th day of rash.



Fig. 6. Case 13.  
26th day of disease. 18th day of rash.





Fig. 7. Case 14.  
11th day of disease. 2nd day of rash.



Fig. 8. Case 14.  
15th day of disease. 6th day of rash.



Fig. 9.

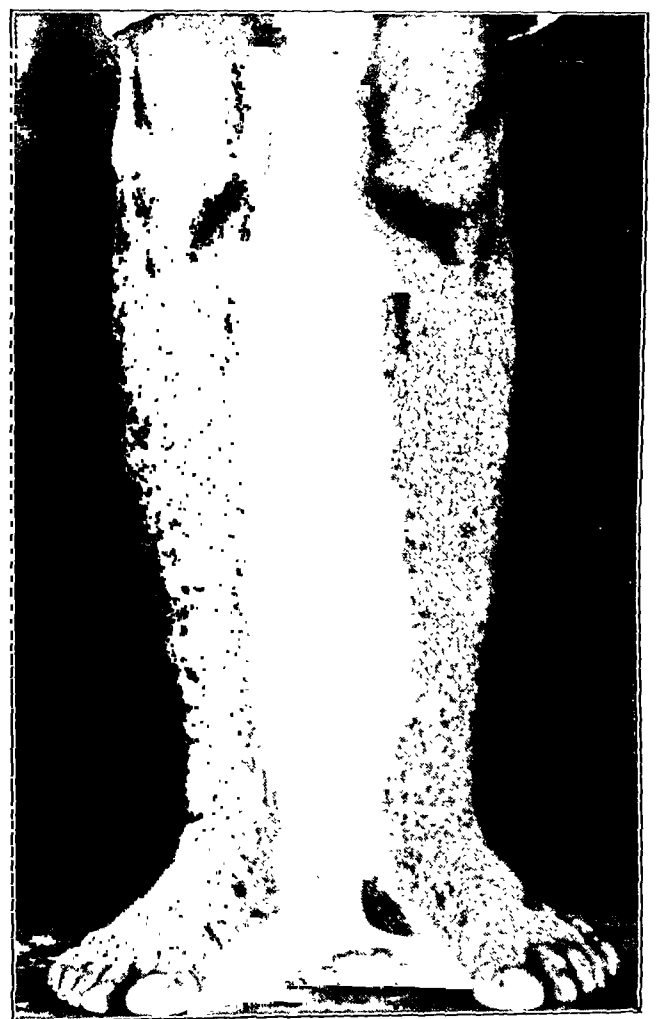


Fig. 10.

Case 14. 20th day of disease. 20th day of rash.

is short and uneventful, recovery speedy and complete.

The leading symptom in our cases is the maculo-papular rash; it was invariably present and appeared between the fifth and ninth or tenth day, rather later than earlier, though it might be difficult to recognize the very first stages. They are pinkish or purplish coloured macular spots fading on pressure, appearing first on the shoulders, the back and the ankles, spreading during the next five to six days downwards along the arms to the fingers and palms, upwards along the legs to the groins, showing finally the richest development on the fore-arms, the lower half of the shins, the wrists and ankles, in some cases also on the back. The gluteal region is usually densely spotted; chest and abdomen are the least affected; the face showed a few coloured spots on the cheeks and chin in four of these cases in the beginning, uncoloured papules in two of them towards the end of the second week. With the spreading of the rash, pinkish-purplish macular, similarly coloured maculo-papular and unstained papular efflorescences are present in the same area, becoming finally deeply stained and to a greater part petechial, at this stage not fading on pressure; all of them remain distinctly separated from each other. Towards the end of the third week the petechial efflorescences are transformed into brown pigmented spots of purely macular character. The photos of case 14 (plate XII) demonstrate the change from almost unstained papular to deeply pigmented macular spots on the fore-arms. During the fourth week peeling takes place to a variable extent, especially on the limbs, the palms and soles; the scales are minute and bran-like; the photo of case 13 (plate XI, figure 6) shows the peeling clearly on the arms. The stained spots remain distinctly visible for weeks and months; in fact they are—

The urine did not show any pathological changes apart from an occasional febrile albuminuria, urobilinogenuria and a few erythro- or leucocytes. In case 13, *Escherichia coli*, in case 14 *Aerobacter aerogenes* was grown on culture; no special treatment was needed against these infections, which had no detectable influence on the course of the disease. The urine of six other cases out of these fourteen was found normal on microscopical and sterile on bacteriological examination. In none of these cases was *Proteus* found.

Apart from a slight constipation, no bowel troubles have been noticed. The examination of the motions showed nothing abnormal.

*Leucocytosis* of 12,000 to 20,000 with a normal differential picture is characteristic for Mysore typhus; the leucocyte count becomes almost normal soon after the fever subsides; a moderate eosinophilia was noticed during the peeling stage in some cases.

*Widal* for typhoid, paratyphoid A, B was negative in all cases.

*Wassermann*, or *Kahn*, or *Kling*—reactions have been examined in eleven cases and at least one of these reactions was positive in four cases during the fever, becoming negative soon afterwards.

*Weil-Felix reaction* was examined in eleven cases, not examined in cases 5, 6 and 7, because permission to draw blood was refused. These were being treated by private practitioners outside the hospital and were seen by one of us (H.).

The reaction was negative in cases 1 to 4, as reported previously, positive in cases 8 to 13, and almost negative again in case 14 on the 11th, 14th, 18th, 21st, 26th and 34th days (plate XII, figures 7 to 10).

The positive results are given in table I:—

TABLE I

| Case number | Designation    | Age | Day of disease | OX 19   | OX K    | OX 2      | REMARKS                    |
|-------------|----------------|-----|----------------|---------|---------|-----------|----------------------------|
| 8           | Mohammedan boy | 3   | 12             | 1 : 40  | 1 : 40  | 1 : 320   |                            |
| 9           | Hindu female   | 30  | 9              | 1 : 160 | 1 : 320 | 1 : 80    |                            |
|             | " "            | 30  | 21             | 1 : 320 | 1 : 320 | 1 : 80    |                            |
|             | " "            | 30  | 27             | 1 : 40  | 1 : 40  | 1 : 80    |                            |
| 10          | Hindu boy      | 15  | 10             | 1 : 40  | 1 : 40  | 1 : 640   | Plate XI, figures 3 and 4. |
| 11          | Brahmin adult  | 60  | 10             | 1 : 40  | 0       | 1 : 640   | Plate XI, figure 5.        |
|             | " "            | 60  | 15             | 1 : 160 | 1 : 20  | 1 : 1,280 |                            |
|             | " "            | 60  | 22             | 1 : 160 | 1 : 40  | 1 : 160   |                            |
| 12          | Hindu adult    | 38  | 9              | 1 : 80  | 1 : 20  | 1 : 160   | Very mild case.            |
|             | " "            | 38  | 12             | 1 : 20  | 0       | 1 : 80    |                            |
| 13          | " "            | 35  | 21             | 1 : 80  | 1 : 40  | 1 : 640   | Plate XI, figure 6.        |
|             | " "            | 35  | 28             | 1 : 40  | 0       | 1 : 640   |                            |
|             | " "            | 35  | 35             | 0       | 0       | 0         |                            |

especially in the third and fourth week—more striking than the rash proper, though it is almost impossible to overlook the fully-developed rash, if the limbs are examined at all.

*Neill-Mooser reaction*.—This is determined by injecting the patient's blood into male guinea-pigs intra-peritoneally. Fever and scrotal swelling occur in the injected animals. Cases 4, 9,

11, 13 and 14 have been examined in this way; only in case 4, reported previously, was the reaction highly positive. It is possible that the other patients came under observations too late to give this reaction; another explanation is that only the murine strains of *Rickettsia* easily and regularly produce a positive Neill-Mooser reaction and that the negative cases have been infected with another strain.

*Rickettsia* are demonstrable in the tunica vaginalis testis of guinea-pigs which show a positive Neill-Mooser reaction; accordingly they have been found in two guinea-pigs, injected with blood of case 4.

*Epidemiology.*—None of these patients was infested with lice or nits; none of them showed signs of mite-bite or remembered to have noticed any of them. All of them lived in extremely close contact with rats and most of them in equally close contact with cattle, which showed tick-infestation; but tick-bite was denied by all these 14 cases.

Some investigations have been conducted in an endeavour to find the vector. Two rats were trapped in the compound where case 5 lived; fleas, caught on them, have been emulsified and injected into guinea-pigs; they showed fever and their blood gave a Weil-Felix reaction up to 1:160 to OX 2, but the same examinations yielded negative results with rats trapped in the dwelling places of cases 9 and 14.

Ticks, recovered from cattle belonging to case 13 (19 ticks of different size) and case 14 (31 ticks of equal stage of development), have been crushed and the sterilized emulsion was injected into guinea-pigs; they did not develop any pathological reaction.

The suggestion set forward by Napier (Editorial, 1936) to trace the infection to other carriers such as dogs, which is in accord with experiences in *fièvre boutonneuse* (Marseille, Tunis), will be followed in subsequent investigations.

*Differential diagnosis.*—The fact that the Wassermann reaction is frequently positive among our hospital patients in general and in some of the typhus cases in particular would render the differentiation from a syphilitic rash difficult; the more so as syphilitic skin eruptions are frequently accompanied by continuous or remittent fever, and by headache and pains in the limbs. The subcuticular deeply-grounded appearance and dull-red colour of the maculoroseolar syphilide resembles the typhus rash indeed; though it appears first on the flanks, it spreads soon to the limbs, rendering the diagnostic task still harder. In this stage, we rely on the absence of the syphilitic adenitis and the almost constant presence of a conjunctival hyperæmia in typhus, to aid in arriving at the right diagnosis, the history regarding a primary sore being unreliable in our patients. The further development of the rash easily clears up

any doubt; whereas the syphilitic roseoles, especially on the neck, are followed by depigmentation (syphilitic leucoderma), the typhus efflorescences develop stained spots where they have been petechial. The differentiation from the later papular syphilide is easier; this is almost always localized along the margin of the hair and in the hairy scalp, set in rings on other parts of the face and accompanied by condylomata lata or moist papules and the typical *plaques muqueuses* on the mucous membrane of the lips, the pillars of the fauces, etc.

The diagnosis has to be made, especially in children, from measles. Fever and conjunctivitis are to be found in both of them; but no bronchitis, and, of course, no Koplik's spots are present in our typhus cases; in measles the temperature comes down for a day or so before the rash appears, which takes place earlier (third to fourth day) than in Mysore typhus. As the rash appeared in some of our typhus children first on the face and was, in fair individuals, pinkish in colour, an early differentiation cannot be based on the rash alone. A reliable feature is the leucopenia in measles, the leucocytosis in typhus.

There is hardly any difficulty in excluding small-pox. Our typhus patients complained neither of severe pain in the back nor of vomiting; the small-pox eruption appears on the third day and is followed mostly by a definite drop of temperature; though in some of our cases uncoloured papules of a somewhat shotty feel were seen on the forehead and near the wrists; they appeared much later and the temperature remained uninfluenced.

#### Discussion

The diagnosis, being now confirmed by positive Weil-Felix reactions in six cases, is established beyond doubt. But the question is still open as to which typhus group the cases observed in Mysore belong.

Following Megaw's (1934) classification according to the vector, it may be said that our cases do not belong to two of his groups. On clinical, epidemiological and social-economical grounds the diagnosis of louse-typhus is most improbable; clinically, because in our cases the fever lasts longer, the rash appears later, is rarely and sparsely found on the face but profusely on the distal parts of the limbs; circulatory disturbances and vascular complications are absent; the prognosis is good, up to the present, without exception, and the recovery surprisingly quick. Not one of our Weil-Felix reactions is predominantly positive for OX 19. Only three of the fourteen infections occurred simultaneously in two opposite houses; only two of these three in one and the same family; it is definitely a non-epidemic disease. None of our patients belonged to the poor classes; all of them were well-to-do people used to personal cleanliness.

Apart from the classical tsutsugamushi or Japanese river fever, Queensland coastal fever,

and mite fever of Sumatra, cases of mite-typhus have been found or suspected in Malaya ('scrub'-typhus), Burma, Assam (Woodhead and Dutta, 1941), Simla (XK type), and the Punjab; in fact where the Weil-Felix reaction was positive for XK only, the mite is most probably the vector. Mite-bite causes characteristic signs in many of these geographical varieties, but not in all of them; 'scrub'-typhus of Malaya shows neither infiltration nor ulceration on the site of the bite and no swelling of the regional glands is to be found. As, therefore, this sign is not reliable for the differentiation, a comparison with the clinical picture, described by Boyd (1935) for thirty-five cases, may further our purpose. The cases analysed by him originated from the Northern, Eastern and Southern Commands, except Poona-Ahmednagar area and Madras District; the seasonal incidence was confined to August-September; the rash was conspicuously inconstant in Indians (one among fourteen), was to be found on the trunk only and no staining was left behind. Weil-Felix reaction was positive for XK only; no co-agglutinins were present. Geographically, seasonally, clinically and serologically our cases are entirely different; there is no reason to assume that mites are the Mysore vectors.

Rat-flea typhus is found all over the world. American endemic typhus, Hone's disease of Australia, Toulon ship fever, 'shop'-typhus of Malaya, and the recently reported endemic typhus of Hawaii (Doolittle, 1941) are some of the best known clinical and geographical groups. Among Indian typhus, 27 cases, reported by Boyd from Bangalore and analysed by him (1935), have been recognized as 'Bangalore type' of rat-flea typhus in the '*League of Nations Report on Typhus Fever*' as early as 1936; it may be mentioned that the vector was not found actually in any case of 'Bangalore typhus' but Boyd suspected the rat flea on clinical grounds. As Sharma's (1940) 56 cases, observed in Bangalore, show exactly the same clinical and serological features as those described by Boyd previously, one is able to summarize the characteristic facts common to both these groups of Bangalore typhus in one clinical picture. Seasonal incidence throughout the year, maximal occurrence from March to July; onset sudden with a rigor; fever lasted for 10 to 14 days in Boyd's cases and up to 16 days in 48 (= 85 per cent) of Sharma's cases. The rash is extremely inconstant, only in a small minority of Indians present, quickly disappearing, without becoming petechial and therefore without development of pigmented spots. Respiratory complications are almost characteristic for Sharma's cases. Serologically, Bangalore typhus is an X 19 typhus; Sharma does not mention whether co-agglutinins have been present; they are regularly found in Boyd's series.

Compared with Mysore typhus, we find no similarity but only differences: during the seasonal maximal incidence in Bangalore (March

to July), not a single case was observed in Mysore; constant appearance of a rigor there, never a rigor here, the absolutely constant rash in our cases, which lasts long and leaves stained spots behind which remain visible for months, the absence of respiratory complications form a picture, far different in every point from that observed in Bangalore. Finally, in none of our cases was a predominance of X 19 agglutinins noticed; the dominant strain in Mysore is X 2.

The clinical picture of rat-flea typhus, reported from all over the world, is similar to that seen in Bangalore and accordingly quite different from the Mysore syndrome; as, moreover X 19 agglutinins are predominant (though accompanied by co-agglutinins for the other strains) in most of the typhus groups of murine origin, it seems very probable that our cases belong to a different vector group.

It remains to be discussed whether our group shows any features in common with tick-typhus. Rocky mountain fever, fièvre boutonneuse (Marseille, Rome, Tunisia, etc.), Kenya fever, South African tick-bite fever (Transvaal, Rhodesia), and Indian tick-typhus are clinical entities, different from each other; practically the only point which they have in common is the presence of agglutinins for X 2 and co-agglutinins for both the other strains with such a variable titre for each of them that serologically this group is called 'the indefinite type'; it is interesting in this connection that just in certain varieties of tick-typhus the Weil-Felix reaction was found negative for many years, like in rocky mountain fever and fièvre boutonneuse. A definite X 2-typhus is not recognized in the literature, but is to be found in Boyd's second group. Fourteen cases, observed in a limited area (Poona, Ahmednagar, Jubbulpore), showed a Weil-Felix reaction predominantly positive for X 2 and co-agglutinins constantly present, for X 19 and XK. Seasonal incidence and clinical picture of this group are very similar to those of our cases. Boyd gives the following descriptions: headache, suffusion of the conjunctivæ, body and joint pains, the rash constantly present with one single exception, especially profusely on the limbs, hands and feet, becoming always petechial and leaving stained spots behind. Respiratory complications were found in one case only; Wassermann reaction was strongly positive in two cases. Every single feature described as characteristic for this Deccan group fits perfectly to our own observations; even the peculiar fact that in one of these cases the rash was visible 'on the roof of the mouth', finds its counter-part in our case 11, where a well-marked enanthema was present on the soft palate. In fact, the similarity is so striking that at a time when we did not know anything about the serological character of our cases, our Weil-Felix reactions being negative, we pointed out the close resemblance between Boyd's X 2 group and our own cases (Heilig and Naidu, *loc. cit.*). The similarity becomes

almost identical by comparing the serological facts in the Deccan and Mysore groups; in both of them and only in these two groups are the agglutinins predominant for *Proteus* X 2.

In none of these X 2 cases was the vector determined; though Boyd mentions their clinical relationship with Indian tick-typhus, he points out how very doubtful the case is against the tick as the vector in most of the cases collected and reported by Megaw and co-workers; he emphasizes 'that it is unwise to confine our suspicions and investigations to this one vector'.

The results of our efforts to trace the vector were almost negative. Neill-Mooser reaction, said to be regularly and easily obtained in all cases caused by murine strains, was positive only in one, negative in four cases. Rat fleas, emulsified and injected, caused fever and a positive Weil-Felix reaction in guinea-pigs only once and even then, only of a low titre. Ticks, picked from the cows kept in the compounds of two cases, did not produce any pathological reaction when injected into guinea-pigs. Investigations carried out on this line in Madras Presidency have been similarly disappointing (personal communication of B. P. B. Naidu). We agree with Boyd in saying that to solve the vector question in Indian typhus is an extremely complicated and puzzling task.

The fact that the Weil-Felix reaction was negative in five of our cases, in some of them, as in case 14, six times between the 11th and 34th day of the illness, tested with fresh antigens from Kasauli,\* does not allow of any definite explanation. Our suspicion that a *Proteus* strain, different from X 19, XK and X 2, might be para-specific for these cases may be repeated.

#### Conclusion

The clinical, epidemiological and serological facts, characteristic for the typhus cases in Mysore, exclude them from the louse- and mite-typhus groups; they differ in every essential point from those observed in the Bangalore type, which is supposed to be a rat flea-typhus.

In every respect Mysore-typhus shows a definite similarity to Boyd's Indian X 2 typhus; the designation 'tick-typhus' is proved to be right only for a small minority of Indian typhus cases. It is doubtful whether ticks are the only vector of X 2 typhus.

Efforts to trace the vector of the Mysore type among rat fleas yielded mostly negative results; cattle ticks, investigated in two cases, did not produce any pathological effects in guinea-pigs.

The fact that the Weil-Felix reaction was positive in six and negative in five cases points towards the possibility of a *Proteus* strain different from the three tested ones being para-specific in the negative cases.

\*The antigens used in case 14 from 1st February to 21st February, 1942, were obtained from Kasauli on the 24th December, 1941, and gave a highly positive Weil-Felix reaction in case 13, a few days before.

(Concluded at foot of next column)

## THE DIAGNOSIS OF ACUTE APPENDICITIS

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ACUTE appendicitis and its complications are responsible for the death of thousands every year; in England and Wales it claims about 3,000, in the United States of America between 15,000 to 18,000 per annum. What the figures are for India, no man can tell, but despite the contention that vegetarian races are less liable to the disease than those races which eat large quantities of meat, there is no surgeon in India, who would fail to bear witness to the multitude of tragedies for which this disease is responsible.

We are often told that appendicitis is a disease of modern times—more accurately a disease relatively recently recognized. The removal of Edward VIII's appendix was regarded as a desperate procedure, not because the operation had never been done before, but because of the fact that the syndrome was not well recognized and the very diagnosis was in doubt. The position briefly was this, that a case of acute appendicitis, which recovered was diagnosed as a 'perityphlitis', but those who succumbed gained the unenviable distinction of dying of 'peritonitis'.

Despite the fact that nowadays everyone is on the look out for appendicitis, and that it has become the commonest cause of urgent coeliotomy, the mortality rates still waver between 2 to 6 per cent even under the best conditions, and the constant plea of operating surgeons is, for still earlier diagnosis, that is for a diagnosis of the disease when it is still acute appendicitis.

The appendix when diseased is not bound to any time table.

(Continued from previous column)

#### Summary

The epidemiological, clinical, and serological facts, observed in fourteen cases of typhus in Mysore, are described.

The differential diagnosis is discussed.

The clinical and serological features of the Mysore type are compared with those of louse, mite, rat flea, especially Bangalore typhus, and Indian X 2 typhus; the differences and similarities are discussed.

Attempts to trace the vector are reported; the difficulties connected with this problem are pointed out.

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To classify any appendix as early or late by the number of hours which have elapsed since the onset of symptoms is pure chicanery; those categories can only be applied when the appendix is seen through an abdominal incision.

On what grounds can an early diagnosis be established? Only by (a) an understanding of the pathology of the disease, and, based on this, (b) the establishment of a definite recognizable syndrome.

The essential point about the pathology of appendicitis is the recognition that it is obstructive in origin. Bowers states that 80 per cent are obstructive in origin, of which 67 per cent were due to an impacted faecolith. Horsley gives 93 per cent as the figure in which the obstructive factor was definite. Personally, I would give pragmatic sanction to the statement that 100 per cent are obstructive in origin, simply because it frees one of the necessity to use terms like 'catarrhal appendicitis', which are a snare and a delusion.

Obstruction of the lumen whilst the mucosa is still viable produces a rise of intraluminal pressure which can mount higher than the arterial pressure of the supply to the organ and precipitate massive gangrene of the wall distal to the obstruction. The degree of completeness of the obstruction determines whether this factor of ischaemia rapidly produces gangrene or not. The appendix is more vulnerable to such a fate because its artery is an end-artery and no circulatory 'reinforcement' is possible. The relatively stout rigid muscular wall resists distension at the expense of the patency of its blood vessels, and thus further weakens the resistance of the organ to ischaemia as a result of distension. The whole of this process, as far as gangrene, can be accounted for simply on a mechanical basis without the assistance of infection. The reaction in the tissues surrounding the organ will therefore be minimal and the preconditions for localization of the infection, when the organ perforates, or permits infection by leakage through its gangrenous walls, will also be at a minimum. Sudden vascular death prohibits inflammatory changes in the wall except at those points where there is healthy tissue in physical continuity, i.e., proximal to the obstruction or where adhesions have provided a collateral supply. At such places, zones or lines of demarcation develop and result in the sloughing off, of part or the whole, of the organ, providing a means of dissemination of the infective contents without the necessity of perforation; (paralleling stercoral ulceration and perforation in other parts of the gut).

When obstruction is less complete, infection can play a larger part, inflammatory processes not only fill the lumen with pus but produce intramural inflammation and inflammatory exudates, which by their action on contiguous tissues facilitate localization.

Pus is more easily localized than is the bloody fluid which issues from a gangrenous

appendix, so that in these cases, where the inflammatory element plays a greater part, the possible consequences of delay may be less serious. Anticipating a little a later stage in the argument, one can here state that the ancillary methods of investigation—leucocyte counts, differential counts of any kind, sedimentation rates, etc.—can only be expected to give any positive information representing deviations from normal in those very cases which are least dangerous, for these investigations are only affected by the presence of inflammatory conditions which do not exist in the completely obstructed gangrenous appendix prior to perforation.

In brief, acute appendicitis is a closed loop intestinal obstruction, which may proceed to gangrene and rupture, and in which inflammatory processes may co-operate or become apparent only as sequelae.

Pathologically, there is therefore a sound basis for assuming that a constant type of history can be expected, i.e., symptoms and signs due to obstruction first, and then those due to inflammation.

#### *The history of the attack of acute appendicitis*

The diagnosis of acute appendicitis can be made more easily and certainly on the basis of history than of clinical signs.

The first most helpful description can be reduced to this mnemonic form. 'First and all the time—pain, next nausea, then tenderness, and finally fever with leucocytosis'. The late Sir D. P. D. Wilkie in his description of acute obstructive appendicitis emphasized that initially the pain was a colic, and that this was followed by localized tenderness in the right iliac fossa. Hamilton Bailey talks about the 'pointing test', indicating that the pain is recognized as being umbilical or supra-umbilical in situation initially, and then moves to the right iliac fossa.

In the above descriptions, the statement is made that the site of pain changes, but no emphasis is laid on the fact that the nature of the pain changes. The pain initially is that due to obstruction, i.e., a colic, and then, in the natural course of the disease, follows the pain due to inflammation, which is far more accurately localized.

Few lay people can give a description of pain and to ask whether the pain initially was a colic is to expect the impossible.

One of the cardinal signs of inflammation is loss of function, or enforced rest. Movement enhances all the signs of inflammation including pain. By application of this fact one can attain to a solution of the problem of history.

The initial pain is a colic, unaffected by movement, makes patient restless and may be eased by pressure (cf. later). It is often very difficult to locate.

The second phase is the development of a 'sore pain' which makes him lie still, resent



movement or pressure, and is further accurately localized by the patient, often, in the early stages, with the tip of one finger.

In the form of a catechism the elucidation of the history becomes something like this:—

Q. Has the pain been the same since it began? A. No.

Q. Where was it in the beginning? A. "All over the abdomen" or "around the navel".

Q. Did moving make it any worse? to which he may answer that he walked about or could not get comfortable in bed whichever way he lay, or that he tried to get his bowels moved but that the pain was not made worse by moving. But, when once the pain had moved to the right iliac fossa, he could not move suddenly, or cough, or sit up without making the pain worse.

This principle of differentiating between different pains is very valuable in differential diagnosis. Take, for example, a leaking duodenal ulcer which can produce all the physical signs of appendicitis without exception, with no spread of the tenderness and rigidity beyond the right iliac fossa. The onset may of course be more sudden, and there may be a very definite history of preceding dyspepsia, but unlike appendicitis the pain is one which enforces immobility from the beginning. This is also true of referred pleural pain in a right-sided basal pneumonia.

There is one important pitfall in the history which must be remembered. Reverting to the pathology of the condition for a moment—the pain which arises from the distension of the organ will be relieved, (a) if the obstruction is relieved or (b) if the sensitive tissues can no longer function, e.g., when gangrene has occurred.

If the history suggests that, fairly quickly, or suddenly, the colic disappeared, there is every reason for regarding the incident with grave foreboding. Within half an hour of perforation or gangrene, there may be little or no tenderness in the right iliac fossa and of course no colic, but unless that patient is operated upon very shortly, 'RIF' may be written of that patient and not 'no tenderness in the RIF'. The patient may of course be fortunate and get a complete remission when an obstructing stercolith has been extruded through the ileo-cæcal valve.

*Nausea and vomiting* may or may not be present and may vary immensely in degree—usually however the patient does not vomit more than two or three times. To regard vomiting as an essential symptom and to wait for it until the patient had developed vomiting due to general peritonitis, is to court disaster. In the older patients, say, 55 to 60 and over, nausea and vomiting are uncommon.

*Physical signs in the diagnosis of acute (early) appendicitis.*

Fever is a very important sign, because it is not to be expected until after the diagnosis is

made. Pain in the right iliac fossa, with fever from the beginning, is not appendicitis. In the older group of patients, fever at any stage is rare. The pulse rate may not be much affected before the development of complications. In young people it reacts more speedily, in old people may show very little change until general peritonitis develops.

Busch and Spivack say that in simple acute appendicitis 6 per cent have a pulse rate over 120 and even in gangrene with perforation only 30 per cent have a pulse rate over 120. It is perfectly reasonable to diagnose acute appendicitis when the pulse rate is still normal. With the development of complications an increase in the pulse rate and a fall in the blood pressure are to be expected. *Tenderness in the right iliac fossa (RIF)* is always present and is the only absolutely essential physical sign but the tenderness may be only slight. In early cases it may be found that localized pressure in the RIF produces an increase in the colicky pain, or a sickening pain in the centre of the abdomen when there is still no definite painful spot in the RIF. The presence of this sign indicates an unperforated appendix and is reason enough for urging operation if the history points to the diagnosis. Occasionally, instead of maximum tenderness about McBurney's point, the maximum tenderness may be found close to the crest of the ileum towards the renal angle—in these cases the appendix is usually retro-cæcal.

*Rigidity* may not be present, especially if the appendix is retro-cæcal (complicating the fact that in these retro-cæcal cases tenderness also may not be very acute). In these cases the overlying cæcum on palpation gives a highly characteristic sensation. All are familiar with the labile 'squelchiness' of the ptosed and gas-filled cæcum (especially noticeable after an aperient has been given). In retro-cæcal appendicitis however this labile squelchiness is lost, and the cæcal wall feels as though it were filled with tiny gas bubbles, or as though the gas being displaced from the cæcum on pressure did so reluctantly through some adhesive fluid. The sign is difficult to describe but is characteristic enough once experienced.

*Cutaneous hyperæsthesia* either to pin prick or by Ligat's test always indicates a pathological process when present, and is sufficient with the history to occasion operation.

I would not be bold enough to assert, as some are inclined to do, that the presence of hyperæsthesia implies an unperforated appendix. In cases seen before the late stages it is early enough to make that statement when visual proof is available.

The absence of hyperæsthesia means nothing one way or another.

*The result of rectal examination.*—One might assert as a prelude that two-thirds of all appendices could not possibly be touched by the longest human index finger assuming that the patient relaxes to the utmost. When the patient

is in pain, is apprehensive of all unorthodox approaches to the secrets of his abdominal cavity, and will not relax, one doubts if every pelvic appendix comes near enough to be touched by the examining finger. If there is pelvic peritonitis, however, rectal examination will always produce pain. It is perhaps necessary to mention that, in a patient suspected of having acute appendicitis, a tender object found in the pelvis by the examining finger is not necessarily the appendix and does certainly not clinch the diagnosis.

Zachary Cope's *obturator and psoas tests*, which seek to elicit pain on external rotation with the knee flexed, and on extension of the thigh, respectively, prove nothing except the presence of an inflammatory lesion near the fascial sheaths of the obturator internus or the psoas magnus. If the diagnosis of appendicitis has already been made on the history, then they are useful, with rectal examination, to indicate very roughly the position of the diseased appendix.

*The rebound test.*—The production of pain in the appendix area or at the umbilicus on pressure over the left colon should only be attempted in chronic cases.

(N.B.—No reference is made to signs of abscess formation or general peritonitis—the whole purpose of this paper is to argue for the certain diagnosis of the disease before these complications set in.)

The physical signs as outlined above merely indicate the presence of a lesion in the right iliac fossa and perhaps help to localize the lesion to a particular quadrant of the fossa. Laboratory investigations have no place in the diagnosis of early acute appendicitis and in the most severe complications of advanced disease may even then give very little help.

As has been explained above, the lesion which is potentially most serious (*i.e.*, the obstructive appendicitis with gangrene in which inflammation has played little or no part) is precisely the type of case in which there is no call made on the cellular protective mechanism, until the disease has passed beyond the stage of simple appendicitis. Take the other extreme—general peritonitis—an examination of blood at that stage on the first occasion might show a leucopenia or a count about normal and only a painstaking analysis of the leucocytes according to their maturity could possibly give an indication of the serious significance of the condition. On the other hand, the diagnosis having been made and action taken, serial examination of the white cells of the blood will give valuable information of that individual's reaction to the known gross pathology. But to let the diagnosis hang on a white-cell count is entirely unsound, and yet it is a pseudo-scientific fallacy to which many are prone. If the diagnosis on the history is acute appendicitis, and fever is present (*e.g.*, in a case which is already late)

what other evidence is required of the presence of an inflammatory reaction?

The recognition of verminous appendicitis may be a matter of largely academic interest, but it offers an explanation of some cases of appendicitis with severe symptoms which at operation show an apparently normal appendix, with a few threadworms or hookworms in the lumen. The feature of these is a history of repeated attacks, occasionally a history of worms in the stools, or the statement that ova have been found on examination may be given. Each attack begins with severe colic, marked localized tenderness in the RIF from the beginning of the attack, marked cutaneous hyperæsthesia, little or no rigidity, an early rise of temperature to 100–101°F., and a pulse rate reaching 100 fairly soon after the onset of the attack. This is described in order to be forgotten. The discovery of ova in the stools of a patient with suspected appendicitis should cause one to put a note on the case sheet that anthelmintics should be given during the period of convalescence after operation.

The application of this method of elucidation of the history to cases suspected of past attacks of appendicitis is perfectly sound, and, if a typical history is obtained, there need be no hesitation in deciding upon operation. Radiological investigation if carried out in order to confirm the diagnosis need concern itself only with (i) confirming the presence of stenosed portions in the appendicular lumen, or (ii) the presence of stercoliths which are of greater diameter than the rest of the appendicular lumen or (iii) of incomplete filling or emptying. Tenderness on direct palpation will only be present if the appendix is still inflamed. The presence of the mechanical factor is sufficient to indicate operation to avert the most dreaded form of the disease.

When a history of abdominal pain which on the above criteria is diagnosed as appendicitis and followed (i) by persistent tenderness in the right iliac fossa, (ii) by a constant unvarying dyspepsia without remissions, or (iii) by a premenstrual dysmenorrhœa, there is then no need to waste time and money on radiological examination.

### Case notes

Two cases are now described which bear on points raised in the preceding paragraphs:—

The first is of a Khasi, aged 40 years, who very firmly adhered to his story that he had fallen off a high wall on to his buttocks nine days before, and that he then got pain in the abdomen, vomited, had diarrhoea, and had difficulty in micturition. He had no temperature and a leucocyte count of 6,000 per c.mm. On examination a hard mass was found on the right wall of the pelvis. On rectal examination this was about the size of a large orange, and seemed to be displacing the bladder upwards. He was so thin that the sub-assistant surgeon examined his sputum for tuberculosis, but this gave a negative result. The suggestion was obviously that we were dealing with a traumatic condition, but closer enquiry revealed, by the kind of

catechism that I have described previously, that the pain in the abdomen was first colicky, then a sore pain which made him lie still. He vomited once after the onset of the colic, and had the diarrhoea after the pain had settled in the right side. The diagnosis of appendix abscess was therefore made, and this was confirmed, after a few days' conservative treatment, by laparotomy. It was ascertained that part of the abscess wall lay against the anterior abdominal wall, and the abscess was then drained by a separate incision without opening the peritoneum.

The second is that of a small boy, aged 2 years, sent in as a case of appendix abscess for immediate operation. When first seen no one could give the history of the case, but he had tenderness in the right iliac fossa with marked rigidity, and by gentle palpation a mass was found in the centre of the right iliac fossa. The child was feverish, temperature 101°F. and any attempt to move the right leg was resisted with loud cries. There were signs that the child had had an impetiginous eruption, but this was completely healed, and there were no enlarged or tender glands in the groin or anywhere else. The theatre was prepared, and the child made ready for operation. In this interval the child's father arrived and gave the following history. Eight days before the child developed fever, and a limp with the right leg, he was absolutely certain that the child had had no pain before the development of the fever. This history immediately suggested that the diagnosis was not appendix abscess but probably suppurating deep iliac glands. A grid-iron incision was made, and the appendix was found to be free and slightly inflamed externally, but the abscess was entirely retro-peritoneal.

### Summary

1. The pathology of acute appendicitis suggests that a constant type of history could be elicited from all cases.

2. Clinical experience supports the deduction, and an indirect method of ascertaining the type of pain is described which enables an accurate history to be obtained even from the uneducated.

3. Physical signs can only confirm a diagnosis made on the history and give an indication of the position of the appendix.

4. The irrelevance of clinical laboratory methods is indicated.

5. Two cases are described which show the value of the method of elucidating the history.

**Bibliography.**—The description of acute obstructive appendicitis as given by Miles and Wilkie (1936) has now passed into most recent surgical textbooks. The physical signs are also to be found in the textbooks of Bailey (1940) and Cope (1940).

Busch and Spivack (1940) have discussed the pulse rate and other factors in assessing the severity of the process in acute appendicitis and its complications.

The obstructive basis of acute appendicitis has been described by Horsley *et al.* (1939), Bowers (1939), and especially Wangenstein (1939), in American literature, whilst Arnheim and Neuhoof (1940) have dealt with the typical history in acute appendicitis and its relation to physical signs.

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## A PLEA FOR REASONABLE ATAVISM IN THE TREATMENT OF FRACTURES

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IN no branch of our work is the active and optimistic co-operation of the patient more necessary than in bone and joint surgery. Before the advent of x-rays, the treatment of fractures was much simpler, the doctor 'set' the broken bone, nobody doubting his word that it was 'set', splints were applied, the doctor paid a daily visit, and the patient proceeded to get well. Nowadays, the patient sees his x-ray pictures—if he does not, he suspects a sinister reason for their concealment—and unless the fragments are in good position he retains the idea that because there is some displacement there must be some disability. By faith and use a good patient can largely overcome this, but unless his doctor possesses hypnotic as well as orthopaedic powers there is always at the bottom of the patient's mind the idea that the result would have been better in more competent hands.

In the lower limbs, and particularly in and near joints, there is an undoubted relationship between the amount of displacement and the amount of disability, and any method which safely puts the fragments in good position is to be commended.

Under the influence and inspiration of Böhler, Watson-Jones and others, the routine treatment of fractures has in recent years completely changed, the 'closed' method being almost universal and the 'open' method rather despised. It is not, however, sufficiently realized that the magnificent results of these masters *cannot* be achieved without profound knowledge and experience, a first class team, nurses wise in orthopaedics, constant attention, proper apparatus, good plaster-of-Paris, and, last but not least, adequate x-ray apparatus, including a good portable set.

How many of these basic necessities are to be found in an ordinary civil or military hospital? Not more than one or two, so that instead of

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getting results like those shown in Böhler's and Watson-Jones's books the general surgeon often has to content himself—but not his patients—with a much lower standard.

What is the remedy? The ideal would be to segregate all difficult fractures in special hospitals with special staffs, who would remain there and not be moved to another place as soon as they had become proficient. As this ideal is obviously unattainable during our lifetime I advise the general surgeon to reconsider plates, screws, grafts and wires, on the strict understanding that these should be used only when the resources at his command do not permit him to put *and maintain* the fragments of a broken bone in good position.

The sort of case that comes to one's mind is the following: ten years ago, when I was civil surgeon, Quetta, I saw a young man with a severe but simple Dupuytren's fracture of the ankle. Manipulate it how we would under the screen, we could not get the lower fragment of fibula into position. I therefore put a small plate on the fracture and screwed the lower end of the fibula to the tibia. Six months later, being president of the local football league, I was presenting a cup to the winning team, in which, to my surprise, I recognized my patient as a prominent player.

Another case, which suggests that sepsis is not always the disaster it seems: some months ago I had to break down and plate a very mal-united fracture of the tibia; conditions were not ideal and I had not anticipated plating, but had to do it as it was the only way of keeping the fragments in position. The case went septic and the wound had to be freely opened after ten days. After a feverish month, I removed the plate and put the leg in plaster. The fragments remained in good position, the wound healed, and the patient is now walking about with a much better leg than he had before the operation. In the above case it was not possible to carry out the correct technique, which should be both aseptic and antiseptic.

By 'aseptic', in addition to what is usually understood, I mean—(a) careful preparation of the skin: the skin is well washed with 40 per cent 'Dettol' on two successive days, the wet shaved skin being covered with a sterile towel; the operation is done on the third day, on the morning of which the skin is painted with tincture of iodine, 1/1,000 flavine or violet-green in spirit, this being repeated on the table; (b) the surgeon and his assistants must be certain that there are no holes in their gloves and that the latter are properly sterilized; as wet sterilization is messy, and gloves in India do not survive the drastic dry sterilization they can endure in England or America, they should be autoclaved for only ten minutes at ten pounds pressure, and painted with iodine or flavine in spirit after they have been put on; (c) 'no touch' technique, nothing that goes into the wound should be

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## EXAMINATION OF CHOLERA VOMIT

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We have found in the literature no record of the isolation of *Vibrio cholerae* from the vomitus of cholera cases. Vibrios can be isolated from a single sample of the vomit in 50 per cent of cases in our experience. A higher percentage of isolation is probable if more than one sample can be examined. Thus a laboratory diagnosis of cholera can sometimes be made by bacteriological examination of the vomitus.

*Isolation of vibrios.*—Sterilized glass pots covered with Petri dishes were kept ready by the bedside of patients, and as soon as the patients vomited, the vomitus was collected directly into the pots and about 2 c.cm. of each sample was at once put into peptone water (pH 9.0). Direct plating was done on bile-salt

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touched even with the gloved hand and the plates and screws should be taken straight out of the sterilizer.

By 'antiseptic technique', I mean the use of 'M.&B. 760' ('thiazamide') powder. The screw holes should be powdered, and two or three times during the operation, essentially just before sewing up, the whole wound should be powdered to its depths with this drug. For five days after the operation thiazamide should be given by the mouth in adequate doses; if it is unobtainable, M.&B. 693 or ordinary sulphanilamide may be used as a powder during the operation and afterwards by the mouth.

Screws and plates should if possible be of vitallium, which is completely inert and harmless to bone. If these cannot be obtained, the old-fashioned Lane's plates and screws give just as good results now as they did in their hey-day thirty years ago, but it is better to remove them after the fracture has firmly united. A plated bone must, of course, be put up in plaster and guarded against lateral stresses and strains just like an unplated bone, otherwise there will be deformity or non-union.

Particularly at the present time, when shortage of doctors and staff renders impossible the employment of a team up to Böhler or Watson-Jones standards, I recommend general surgeons to look once again with favour on open operation for cases which cannot otherwise be kept in really good position, and if they observe the principles outlined above I think that they and their patients will have some pleasant surprises.

agar in the laboratory about two hours later. Sometimes to induce vomiting, sterile distilled water was given to drink.

| Cholera cases | Vomits showing vibrios                | Percentage |
|---------------|---------------------------------------|------------|
| 52            | 26                                    | 50         |
|               | Agglutinable vibrios .. 11            |            |
|               | NAG vibrios .. 5                      |            |
|               | Lost before typing .. 10              |            |
|               | Positive on direct plating only .. 13 |            |
|               | Peptone water enrichment only .. 3    |            |
|               | Positive by both methods 10           |            |

The above table shows that direct plating gave a higher percentage of positive results. This is probably due to the fact that coliform organisms present in the vomit cannot overgrow the vibrios when the vomit is plated direct on bile-salt agar. In some samples, vibrios were isolated in pure culture on direct plating. By the direct plating method, no vibrios were found in 3 samples in which isolation was successful by the enrichment method. On the other hand, direct plating gave positive result in 13 samples in which the enrichment method failed. Thus it appears advisable to use both the methods for isolation of vibrios from vomitus.

#### Reaction of vomits :—

| pH of vomits | Number of cases | Number of samples positive for vibrios |
|--------------|-----------------|--|
| 2.4 to 4.9   | 12              | 0                                      |
| 5.0 to 5.9   | 7               | 4                                      |
| 6.0 to 6.9   | 19              | 10                                     |
| 7.0 to 8.4   | 14              | 12                                     |
| TOTAL        | 52              | 26                                     |

The commonest pH was from 6.0 to 7.5. Isolation becomes common at a pH above 6.0 and is highest above 7.0. Vibrios being highly sensitive to acids, none were found at a pH below 5.0. Gastric contents were acid in 38 samples out of 52.

**Sodium chloride content.**—The amount of sodium chloride present in the vomitus varied from 66 to 821 mg. per 100 c.cm. and bore no relation to the hydrogen-ion concentration of the vomits. For example, at pH 6.0, the amount of sodium chloride varied between 122 and 293 mg. per 100 c.cm. It was 122 mg. in one patient who had no water to drink before the vomit was collected, 283 mg. in another similar patient, and 293 in a third patient who drank a little tap water before collection of his vomit.

**Types of vibrios isolated.**—Only one type of vibrio was isolated from one and the same vomit, Inaba sub-type from 3, Ogawa sub-type from 8 and non-agglutinating (NAG) type from 5 vomits.

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## PROTEOLYTIC SYSTEM IN NORMAL AND VARIOUS PATHOLOGICAL CONDITIONS

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It is generally recognized that certain pathological conditions influence metabolic processes. Intensive changes in nitrogen metabolism are associated with a large variety of diseases, such as febrile stages of acute infectious diseases, severe diabetes, nephritis and other diseases of the kidney, toxæmias of pregnancy, kala-azar, cancer, etc. It seemed probable that such changes in nitrogen metabolism would be reflected in some way in the proteolytic system of blood. Becher (1933) has suggested that the increased nitrogen metabolism often observed in renal insufficiency may be brought about in part by the retention of proteolytic ferments. Increases in katabolism of body protein are reported to occur when nitrogen retention is the

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Ten strains were lost before typing. As a rule, vibrios from vomits were serologically identical with those isolated from stools of the same case. It is interesting to note that a few cases showed the presence of only NAG vibrios in the vomitus whereas Ogawa sub-types were present in the stools of those cases. It is proposed to study further the correlation between the vibrios in vomits and stools. It is also interesting to note that in five cases agglutinating vibrios were isolated from the vomitus but isolation from the stools collected on the same day was not successful. Thus it appears that an examination of the vomitus will serve as an additional valuable method for bacteriological diagnosis of cholera.

#### Summary

1. Cholera can be diagnosed bacteriologically by examination of a single vomit on direct plating as well as by plating after primary enrichment in alkaline (pH 9.0) peptone-water in about 50 per cent of cases.

2. As a rule, vibrios isolated from vomits and stools of the same patient are serologically identical but discrepancies have been met with.

3. The pH of the vomit varies between 2.4 and 8.4, but it is usually above 6. No vibrios are isolated from vomits with a pH less than 5. The higher the pH, the more commonly are vibrios isolated.

4. The amount of sodium chloride in the vomitus varies widely from 66 to 821 mg. per 100 c.cm. and bears no relation to the hydrogen-ion concentration of the vomitus.

result of extra-renal causes, *e.g.*, extreme dehydration (MacKay and MacKay, 1924). Tumour and embryonic growths are characterized by rapid cell division which involve, among other things, an intensive protein metabolism for building up the protein constituents of the cell. Weil and Russell (1938) have shown that during tumour growth or pregnancy in rats, the plasma proteinase activity drops considerably. When the tumour is removed by operation or after termination of pregnancy, the proteinase activity returns to the normal level.

The study of the proteolytic system in blood in its relation to various pathological and clinical conditions has not received the attention it deserves. Abderhalden (1937) and Hedin (1919) have demonstrated the presence of a proteinase in serum, active near neutrality. Schmitz (1937) and Iyengar and Scott (1940) have clearly shown that the proteinase circulating in blood is of a tryptic nature. Cooke (1932) has reported that blood protease is increased in chronic myeloid leukaemia. Loeper *et al.* (1932) have conducted experiments which indicate that the decrease in serum albumin during renal impermeability, whether due to nephritis or to ligation of the renal pedicle, is partly due to retention of proteolytic enzymes in blood. Vercellana (1935) has reported that trypsin is practically absent in blood from six cases of carcinoma. Ferranti and Slavich (1937) have found a high protease content in diabetes. However, there is no record of a systematic study of the plasma trypsin, both free and combined, in a number of pathological conditions commonly met with in hospital practice. This study was taken up to ascertain whether altered protein in the body as a whole brings about any changes in the enzymic content of blood.

## EXPERIMENTAL

### I. Materials and methods

(a) Determination of free plasma trypsin activity:—Two c.cm. of citrated plasma are precipitated with 8 c.cm. acetone and centrifuged. The precipitate is washed with acetone and allowed to dry for a few minutes. The whole precipitate is then mixed with 10 c.cm. of phosphate buffer of pH 8.4 in a glass mortar to get a uniform suspension. Three c.cm. of this suspension are taken in a test-tube and 3 c.cm. of 10 per cent trichloroacetic acid are added to it. The contents are well shaken and filtered. The nitrogen content of 3 c.cm. filtrate is estimated by the micro-kjeldahl method. A few drops of toluene are added to the remainder of the suspension which is incubated at 37°C. for 48 hours. At the end of this period, 3 c.cm. of this suspension are mixed with 3 c.cm. of 10 per cent trichloroacetic acid, filtered, and the nitrogen in 3 c.cm. of the filtrate is estimated. The increase in non-protein-nitrogen (NPN) is taken as a measure of tryptic activity of plasma. The

tryptic activity is finally calculated for 100 c.cm. of plasma in terms of the increase in NPN.

(b) Determination of total plasma trypsin (both free and combined):—Two c.cm. of citrated plasma are precipitated with 20 c.cm. of 2.5 per cent trichloroacetic acid and centrifuged. The precipitate is once washed with 2.5 per cent trichloroacetic acid and then twice with acetone. The final precipitate is treated in the same manner as above and the increase in NPN determined. By treatment of plasma first with trichloroacetic acid, the trypsin-inhibitor compound is dissociated into its components. The inhibitor being a low molecular weight polypeptide is not precipitated by trichloroacetic acid, whereas both the original free trypsin and the newly liberated trypsin being associated with plasma proteins are precipitated. This precipitate, after being washed with acetone, will be free from trichloroacetic acid and the total tryptic activity of the protein precipitate is indicated by increase in NPN after auto-digestion in the suitable phosphate buffer for 48 hours.

(c) The amount of trypsin inhibitor present in plasma was determined by the difference between the free tryptic activity and the total (free and combined) tryptic activity of plasma.

## II. Results

The results of the determination of free and total plasma trypsin content in a number of normal cases and in various pathological conditions such as cancer, diabetes, kala-azar, filaria, nephritis, acute infectious diseases, anaemia, thrombocytopenic purpura, etc., are given in the following table:—

TABLE

| Pathological conditions | Serial numbers   | Free plasma trypsin content                       | Total plasma trypsin content | Difference |    |
|-------------------------|------------------|---|------------------------------|------------|----|
|                         |                  | expressed as increase in NPN for 100 c.cm. plasma |                              |            |    |
| Normal                  | 1                | 15.4  | 75.2                         | 59.8       |    |
|                         | 2                | 18.8  | 84.6                         | 65.8       |    |
|                         | 3                | 24.6  | 78.1                         | 53.5       |    |
|                         | 4                | 16.2  | 75.2                         | 59.0       |    |
|                         | 5                | 32.8  | 69.4                         | 36.6       |    |
|                         | 6                | 18.4  | 74.6                         | 56.2       |    |
|                         | 7                | 28.9  | 82.1                         | 53.2       |    |
|                         | 8                | 41.4  | 84.5                         | 43.1       |    |
| Cancer of—              |                  |   |                              |            |    |
|                         | Stomach          | 1   | 2.1                          | 8.9        | .. |
|                         | "                | 2   | 4.6                          | 12.2       | .. |
|                         | Penis            | 3   | 3.8                          | 9.8        | .. |
|                         | Colon and rectum | 4   | 6.2                          | 12.4       | .. |
| Bladder                 | 5                | 4.6   | 10.8                         | ..         |    |



TABLE—concl'd.

| Pathological conditions    | Serial numbers | Free plasma trypsin content                       | Total plasma trypsin content |
|----------------------------|----------------|---|------------------------------|
|                            |                | expressed as increase in NPN for 100 c.cm. plasma |                              |
| Diabetes .. ..             | 1              | 35.0  | 68.4                         |
|                            | 2              | 46.6  | 76.8                         |
|                            | 3              | 55.2  | 81.4                         |
|                            | 4              | 38.6  | 72.8                         |
|                            | 5              | 41.4  | 64.8                         |
|                            | 6              | 32.4  | 66.9                         |
| Kala-azar .. ..            | 1              | 18.5  | 65.8                         |
|                            | 2              | 22.6  | 72.7                         |
|                            | 3              | 16.8  | 75.2                         |
|                            | 4              | 28.9  | 68.4                         |
|                            | 5              | 19.9  | 72.6                         |
| Filariasis .. ..           | 1              | 17.4  | 74.8                         |
|                            | 2              | 18.9  | 72.5                         |
|                            | 3              | 22.4  | 69.4                         |
|                            | 4              | 32.8  | 68.8                         |
|                            | 5              | 19.4  | 74.2                         |
|                            | 6              | 25.6  | 69.9                         |
| Nephritis .. ..            | 1              | 48.6  | 70.8                         |
|                            | 2              | 56.8  | 68.6                         |
|                            | 3              | 39.4  | 74.6                         |
|                            | 4              | 46.8  | 68.9                         |
| Acute infectious diseases— |                |   |                              |
| Typhoid .. ..              | 1              | 24.6  | 69.7                         |
| " .. ..                    | 2              | 32.8  | 58.8                         |
| " .. ..                    | 3              | 31.4  | 64.6                         |
| Smallpox .. ..             | 4              | 18.4  | 59.8                         |
| " .. ..                    | 5              | 26.2  | 71.6                         |
| Anæmia .. ..               | 1              | 8.1   | 18.9                         |
|                            | 2              | 2.4   | 17.6                         |
|                            | 3              | nil   | 14.2                         |
|                            | 4              | 3.2   | 18.5                         |
| Thrombocytopenic purpura   | 1              | nil   | 12.4                         |
|                            | 2              | 2.1   | 16.8                         |
| Miscellaneous—             |                |   |                              |
| Obstructive jaundice ..    | 1              | 32.8  | 84.5                         |
| " .. ..                    | 2              | 41.6  | 78.6                         |
| Biliary fistula .. ..      | 1              | 39.4  | 79.8                         |
| " .. ..                    | 2              | 42.8  | 82.9                         |
| Cirrhosis of liver .. ..   | 1              | 38.2  | 79.7                         |
| Hæmophilia .. ..           | 1              | 1.8   | ..                           |

### Comment and discussion

The free trypsin content of normal plasma is found to vary within fairly wide limits, whereas the total tryptic activity appears to be constant within reasonable limits considering the fact that we are dealing with a biological entity which is bound to vary from individual to individual. It should therefore be concluded that the inhibitor is present in varying quantities. The blocking of trypsin depends upon the amount of the inhibitor present. This variation in the

quantity of the inhibitor is reflected in the last column of the table wherein is expressed the difference between free trypsin and total trypsin in each subject. The average value (free trypsin content) for the increase in NPN for 100 c.cm. plasma as a result of auto-tryptic activity can reasonably be taken as 24 mg. as most of the values are round about this figure for normal cases.

If this average value is taken as the basis for comparison, a significant fall in the free tryptic activity of plasma is noticed in cancer patients. This reduction in tryptic activity of plasma cannot be due to any increase in the amount of trypsin inhibitor circulating in the blood, since the total (free and combined) tryptic activity has also undergone a radical fall from a normal average value of 77.9 mg. to 10.9 mg. At the present state of our knowledge of cancer, it is impossible to speculate on the cause of this reduction. If, as is generally recognized, the origin of plasma trypsin is from the formed elements in blood, it must be assumed that the formed elements have somehow lost the capacity of synthesizing this enzyme. Weil and Russell (*loc. cit.*) have found that the proteinase activity is restored to normal after the removal of tumour in rats by operation. It is likely therefore that the reduction in the trypsin content of plasma is more a manifestation of the disease rather than a causal factor. The malignant growth can only be digested by the proteolytic enzyme of the blood circulating through the tumour tissues. When the trypsin is practically absent the chances of the removal of the growth by enzymic digestion are very much reduced. This is probably the reason why the auto-regression of the tumour is rarely observed in clinical practice.

In diabetes, there appears to be a tendency for the free trypsin in plasma to rise. The average value is 41 as compared to the average normal value of 24. Though this cannot be regarded as very significant, it definitely points to an increase in trypsin content of plasma. The total trypsin content does not undergo any appreciable change. It is probable therefore that the observed rise in the free trypsin content is due to a lowered amount of inhibitor present in blood in diabetes. It is possible that the deranged carbohydrate metabolism in diabetes may be responsible for the deficiency in the formation of inhibitor in the blood.

No significant change either in free or combined plasma trypsin in kala-azar, filaria or acute infectious diseases, *e.g.*, typhoid and smallpox, is observed. Although a rise in free plasma trypsin content is noticed in obstructive jaundice, biliary fistula and cirrhosis of liver, the number of cases experimented upon is too meagre to warrant any definite statement.

A significant increase in free trypsin content of plasma is observed in nephritis. The average value is 47.7 as compared with the normal of 24. In nephritis the degree of nitrogen accumulation in blood depends not only on the functional

efficiency of the kidney, but also on the rate of protein katabolism. The increased trypsin content is probably an index of enhanced protein katabolism.

In anæmia and thrombocytopoenic purpura, the free trypsin is almost negligible. The total trypsin (free and combined) is also considerably reduced. These results lend very interesting experimental evidence to the popularly accepted belief that the trypsin in plasma is derived from the break-down of formed elements in blood during circulation. As the red blood corpuscles and the platelets are very much reduced in anæmia and thrombocytopoenic purpura, respectively, the two important sources of trypsin supply to blood are not available and this is probably reflected in the very low free and total trypsin content of plasma.

Ferguson (1939) has explained the delay in the coagulation of hæmophilic plasma as due to a deficiency in the amount of thromboplastic enzyme. This enzyme is reported by the same author to be very much similar to trypsin. Iyengar (1942) has adduced experimental evidence in favour of the hypothesis that the physiological thromboplastic substance circulating in blood may be trypsin itself. It was therefore considered of great interest to study the trypsin content of hæmophilic plasma. It is very difficult to get a genuine case of hæmophilia. Advantage was taken of a bleeding case admitted to the Carmichael Hospital for Tropical Diseases, which was suspected to be hæmophilia with a very prolonged clotting time. The free plasma trypsin was found to be almost negligible.

#### Summary

1. In view of the generally recognized rôle of trypsin in various physiological processes, e.g., nitrogen metabolism, blood coagulation, destruction of hormones in the circulating blood, etc., a systematic study of the plasma trypsin contents in normal and various pathological conditions was undertaken.

2. The free trypsin content of the plasma in normal individuals was found to vary from 15 mg. to 41 mg. per 100 c.cm. of blood with an average reading in majority of cases of 24 mg. The total trypsin content was found to maintain a constant level in all the cases studied.

3. In cancer, the free trypsin content of the plasma showed a definite diminution whereas in diabetes and nephritis, there is either a tendency to increase or a marked increase in the content of free trypsin. In anæmia and thrombocytopoenic purpura, both the free and total trypsin are practically absent. In filarial conditions, kala-azar and acute infectious diseases, such as enteric, variola, etc., no significant change in the trypsin contents was observed.

4. The possible explanation of such differential changes in normal and in the pathological conditions studied has been attempted.

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## DETERMINATION OF THE AGE IN BENGALI GIRLS IN MEDICO-LEGAL CASES—SOME PRACTICAL DIFFICULTIES. THE ROLE OF X-RAY EXAMINATIONS OF BONES \*

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DURING my tenure of office, for nearly 10 years, as police surgeon of Calcutta and professor of medical jurisprudence of both the medical colleges in Calcutta, no other subject presented so many difficulties and peculiarities as the determination of age in girls in medico-legal cases. So I thought that I would get some of my difficulties solved by bringing in this subject before you and starting a discussion.

I will put the subject before you in a simple way especially in connection with the cutting and growth of the teeth, and the union of the ends of the long bones to the shafts and the age at which this happens in our girls. Incidentally, examination of the teeth and the examination of the bones by x-rays are the two most important items in this connection.

Lately, I have noticed that there is a great tendency amongst lawyers to pin their faith on

\* A résumé of a paper read at the Campbell Medical College Reunion.

(Continued from previous column)

#### Acknowledgment

The authors' thanks are due to Sir Ramnath Chopra, Dr. L. E. Napier, Dr. C. R. Das Gupta, Dr. S. Sundar Rao, Dr. J. P. Bose and several others who have kindly afforded facilities to take specimens of blood from their patients. They are particularly grateful to Sir Ramnath Chopra for his sustained interest in this investigation.

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x-ray findings of bones. The question invariably asked was 'Doctor, is not x-ray the surest way of finding the real age of a girl?'. I may tell you at once, it is not. It has not improved matters very much. They want to know, for instance, whether a girl on the day the offence is committed was 14 years, or over or under. There is nothing by which you can say whether the girl is exactly 14 years or one day older or one day younger. Section 372 I. P. C. says—

'Whoever sells, lets to hire, or otherwise disposes of any person *under the age of 18 years* with intent that such person shall at any age be employed or used for the purpose of prostitution or illicit intercourse with any person or for any unlawful and immoral purpose, or knowing it to be likely that such person will at any age be employed or used for any such purpose, shall be punished with imprisonment of either description for a term which may extend to 10 years, and shall also be liable to fine.'

Section 375 I. P. C. says:—

'A man is said to commit "rape" who, except in the case hereinafter excepted, has sexual intercourse with a woman under circumstances falling under any of the five following descriptions—1, 2, 3, 4, and 5 with or without her consent, *when she is under 14 years of age*.'

'Whoever commits rape shall be punished with transportation for life, or with imprisonment of either description for a term which may extend to 10 years and shall also be liable to fine, etc., etc.'

With our present-day knowledge we may make a mistake of 1 to 3 years. Even with my long experience I may make a mistake of 6 months this side or the other side of the real age of the girl. I can never give the correct age. I always say, for instance, that a girl is about 15 years of age, that is to say, she may be 14 years 6 months to 15 years 6 months.

I may here give an instance of two sisters I had examined in connection with the Immoral Traffic Act in Calcutta. I examined a girl named Binapani brought to me by the police after they had rescued her from a brothel in the northern part of the city. After carefully examining her, I gave my opinion that she was about 16 years of age on the date of examination. A few days later, another girl named Saraswati was rescued from a neighbouring brothel in the same locality and sent up to me for examination. In this case also I gave my opinion that the girl was about 16 years of age. Whilst deposing in court I found that the two girls were sisters. Binapani was 16 years and 5 months old and Saraswati was 15 years and 6 months old, these two sisters having been born within one year of each other.

Now a healthy child when born is a perfect human being for all practical purposes. Of course, during the first 10 days or so, it is adjusting itself to its new surroundings. As is well known to you that before its birth the foetus floats in a bag of fluid almost like water and so its respiratory apparatus does not work, it gets all its nourishment and water from the mother through the placenta and the umbilical

cord and it purifies its blood through the mother's blood and so on. Immediately after birth, it has to breathe and purify its own blood through its own lungs, its circulatory system has to adapt itself to its new way of living, it has to imbibe its own nourishment and excrete its own waste products through its own systems concerned. After this initial period it continues to grow. Now what do we mean by the word 'grow'. Broadly speaking, mother nature does three things. Firstly, the mind of the baby begins to form and gradually goes on developing. Secondly, she makes the baby fit so that it will survive the struggle for existence and continue to live. Thirdly, she makes the baby fit gradually to be able to reproduce its own kind. All these in the case of human being takes about 16 to 18 years, and, after the end of this period, it is a complete natural being, able to think and act for himself, get its own food and is able to mate and reproduce its own kind. For our purpose its growth has ceased. Now all these facts connected with the growth of the being are taken advantage of by medical men for the determination of its age, say up to the 18th year of its life. That is to say, we can very approximately form an idea of its age after examining the various parts of its body including the growth and completion of the formation of the bones by x-ray examination. After this age there is nothing which is of slightest use to us in determining its age. For instance, a person may look to be 25, but may be 30 or 35.

Now let us see what facts or factors we consider while trying to determine the age of a girl. First, general appearance and development; second, the height; third, the weight; fourth, the cutting and growth of the teeth; fifth, signs of approaching puberty, namely, (i) the development of the breast, (ii) growth of hair in the arm-pits and over the pubic region, (iii) establishment of menstruation, (iv) general enlargement of the external genitals, (v) alteration of the disposition of the girl, and (vi) fuller contour of the body, namely, enlargement of the hips, general gracefulness, etc.; sixth, the x-ray examination of the bones to see how far their growth has taken place, and lastly seventh, the degenerative changes. As you know, most of these except the teeth and the bones do not help us very much. As a matter of fact these taken individually are of little use to us, but all of them considered together, an experienced doctor can give a fairly approximate idea of the age and his mistake may be within a year of the real age, i.e., 6 months more or 6 months less than her exact age. However I will take these up one by one and see how far we can rely on them.

I. *General appearance and development.*—This as you know is very unreliable. I will tell you how in an unguarded moment I let myself down once. I was asked by a friend of mine to go and examine his sister who was not well. She was a girl from western India. She was seated

on a bed when I saw her and she appeared to me at first sight to be about 17. I examined her and before writing the prescription I asked her mother about her age. She told me that her daughter was about 26 years of age. I was taken by surprise and I asked her if she was sure because to me the girl looked like 17. In spite of this, by experience gained after examining a large number of girls, we can have a rough idea of the age from the general appearance and development of the girl. The important thing is to look carefully at her face before forming the idea.

II. *Height*.—As you know there is no standard of height of our girls worked out which is of any use to us. The girl goes on growing taller and taller, so long the long bones are not completely ossified. As soon as the bones are completely ossified her growth in length ceases and she remains more or less constant. A girl generally shoots up about the age of 11 or 12, and may cease to grow after 14. Some of them may go on till 16 or 17. I shall tell you later how this growth takes place in connection with the bones. A healthy Bengali girl should be about 5 feet and 1½ inches tall at 16 and should weigh about 8 stone and 1 pound.

III. *Weight*.—This also varies very much and there is no standard on which we can depend for our guidance.

IV. *The teeth*.—As is well known, we have two sets of teeth, namely, the milk or temporary teeth and the permanent teeth. The milk teeth are 20 in number and are small, delicate, not meant for crushing or chewing hard substances. They begin to cut when the baby is about 6 months old and they all finish cutting about the age of 24 months. After this, up to the age of 6 years, they continue to grow in size, become bigger and rise higher and higher on the jaws till the whole crown (that is, the visible part of the teeth above the gum) is well up. There are two incisors, one canine and two molars or grinders in each half of each jaw. In the beginning they completely fill up all the available space in the alveoli of the jaws, but as the child grows older its jaw grows bigger and space becomes available for the cutting of the first permanent teeth behind them.

The permanent teeth begin to cut about the age of 6 years and it is the first molar which is first to cut, usually before any of the milk teeth are shed. The jaws become bigger and bigger and space becomes available behind for the cutting of the second and the third permanent molars. If, for defective growth or any other reason, space is not available we get lots of trouble with the cutting of the third molar which is also called the wisdom tooth or *akkal danth*. All the other permanent teeth appear in the space in front of the first molar, which is occupied by the milk teeth and which are gradually replaced by them. There are two incisors, one canine, two bicuspid or premolars, and three molars or grinders of the permanent set in each

half of each jaw. I have examined the cutting and growth of the teeth in a fair number of children of known ages and to my mind the following table gives an approximate idea of the age of their cutting. These are entirely approximate. There may be difference of 1 or 2 months in each case. For all practical purposes the figures are useful.

#### *Milk teeth*

| Order of cutting     | Name of tooth            | Age                         |
|----------------------|--------------------------|-----------------------------|
| 1                    | Lower central incisor .. | 6-8 months                  |
| 2                    | Upper central incisor .. | 9 "                         |
| 3                    | Upper lateral incisor .. | 10 "                        |
| 4                    | Lower lateral incisor .. | 10 "                        |
| 5                    | First temporary molar .. | 12 "                        |
| 6                    | Canine ..                | 18 "                        |
| 7                    | Second temporary molar   | 24 "                        |
| <i>Permanent set</i> |                          |                             |
| 1                    | First molar ..           | 6 years                     |
| 2                    | Central incisors ..      | 7 "                         |
| 3                    | Lateral incisors ..      | 8 "                         |
| 4                    | Anterior bicuspid ..     | 9 (9-10)                    |
| 5                    | Posterior bicuspid ..    | 10 (10-12)                  |
| 6                    | Canine ..                | 11 (11-12, rarely 13).      |
| 7                    | Second molar ..          | 12 (12-13)                  |
| 8                    | Third molar ..           | 17-25 (generally about 18). |

In these also the ages are approximate, the ages of their cutting may vary by 1 or 2 years, especially in the case of bicuspid and canines. Now it is apparent that a girl aged 12 or little over should have cut all her teeth, except the third molars. After the cutting of the second molar, a space is becoming available for the cutting of the third, they are gradually coming up, pushing up the muco-periosteum above them and about the 18th year the crowns of these teeth cut through the muco-periosteum and become visible. In my experience I have found that the third molars cut in a very large majority of girls about the age of 18. Of course, there are some variations, but these are almost always on the side of precocity, rarely on the other. This is a very important point to note. You will remember that the second molars, that is to say, the immediate predecessors of the third molars, are generally cut about the age of 12 or a little later. The jaw is getting bigger and a space is becoming available for the coming of the third molar. This begins to come up at the age of 16, pushes up the muco-periosteum and can now be seen or felt behind the second molar. Before actually cutting, it rises higher and about the age of 18 it comes through and is visible. Therefore when examining the teeth of girls who look 16, or about 16, we must carefully note the condition of the coming of the third molar. There is another very important point about this. The third

molars, especially the upper ones, are sometimes deflected so that they are not visible or felt just behind the second, but are on the lateral aspect of the gum. So we are likely to miss this tooth, if we are not careful, more especially if we remember that the third upper molars are comparatively smaller than their brothers.

V. *Signs of approaching puberty.*—Nature begins to prepare the girl for mating and conceiving. She is made attractive and her organs of reproduction both external and internal get mature and become fit for reproducing her kind. These begin about the age of 12 in healthy girls, and by about the 14th year she is generally sexually mature.

(i) *The breast.*—These two modified sweat glands are accessory glands of the generative system. They are present in males as well as in females, but in the former they remain mostly in the rudimentary state. In the female, they are two large hemi-spherical eminences lying within the superficial fascia on the front and sides of the chest. Each extends vertically from the second to the sixth rib and transversely at the level of the fourth costal cartilage from the sides of the sternum to near the mid-axillary line.

In weight and size they differ at different periods and in different individuals. Before puberty, they are small but they enlarge as the generative organs become more completely developed. On the superficial surface of the breast is a conical prominence called the nipple or papilla situated about the level of the fourth intercostal space. The breast begins to enlarge about the age of 12 and by about 14 years they are generally fully formed. I have seen fully formed breast in girls aged about 11; on the other hand I have seen girls of 15 who had small breasts.

(ii) *Growth of hair* (in the arm-pits and over the pubic region).—Over these places the hair begins to grow about the age of 11. At first, it is very thin downy soft and pale coloured. It gradually becomes thicker, coarser, and black, and by about the 14 or 15th year, it is fully developed and may be one or two inches long. But I have seen fairly formed hair in girls aged about 10, especially among the Jews. On the other hand, I have seen women of 17 or 18 with practically no hair in the arm-pits and very scanty hair over the pubic region.

(iii) *Establishment of menstruation.*—The period at which this takes place varies very much amongst our girls and for our purpose it is equally useless. A daughter of a friend of mine menstruated at the age of about 11 and became a mother at the age of about 12.

Regarding other items under this heading all are equally unreliable and are of very little use to us.

VI. *The x-ray examination of the bones.*—I will tell you what exactly happens in the bones which we x-ray and utilize for forming an idea

of the age of a girl. All workers on the subject agree that the completion of the growth of the bones in this country takes place much earlier than in Europe and America. It may be anything up to 1 to 3 years. Again, we have found that the same bone which has united and completed its growth, say at 14, has not done so in another girl at 18. For instance, it was found that the upper end of the humerus had united at 14 in one girl, whereas in another girl (my own daughter) it had not united when she was 17 years and 8 months old.

I will tell you now in a very simple and unscientific language what actually happens and how bones are formed and how we take advantage of this. When the embryo is only about 2 or 3 weeks old and is only about 1/8th of an inch long, it is still a mass of cells variously differentiated. Before this period there are no limbs. A little later two limb-buds appear, one for the future upper extremity and the other for the lower. They are also masses of cells but have their own blood and nerve supply, etc. In the places in the limbs where the future bones are going to be, the cells become concentrated and converted into rods of hyaline cartilage. About the 8th week of its intra-uterine life, when the foetus is about one inch long, due to the influence of some of the internal secretions (anterior pituitary and the thyroid glands), hyperæmia and increased blood supply takes place about the middle of the long bones and calcium salts are deposited. This is the appearance of the primary centre of ossification and the beginning of the formation of the bones. This grows on all sides more specially towards its ends and forms a cylindrical piece of bone at the expense of the cartilage. At the time of birth the limb has the shaft or middle portion made up of the bone and two ends which are still cartilages. After the birth of the child the ends receive their centres, called the secondary centres, and are transformed into bones, the period being different for the different bones. Therefore, during early years of life the so-called bone consists of the rod or shaft of bone in the middle formed from the primary centre, a piece of bone at each end formed from the secondary centre, and a piece of cartilage in between the two where the growth in length of the bone takes place. After a certain number of years this cartilage disappears having been replaced by bone, union having taken place between the two, thereby completing the growth of the bone. After all the long bones are united, growth in length of the person ceases. The object of x-ray is to see the condition of this cartilage, whether it is present, what is its thickness, whether it is wholly or partly replaced by bone, etc. I have told you before that this age of union of the different long bones varies very much between Indians, Europeans and Americans. Now I shall tell you of the practical difficulty that I used to find in my daily work in determining the ages of girls sent to me. Those who have

worked on the bones for finding the ages of union have worked on girls of *known* ages and have given us the ages at which they found the bones have united. But what happens to us? A girl of *unknown* age is sent to us. We thoroughly examine her and examine some of her long bones with x-rays, and note the stage of the ossification of the bones especially of the intervening cartilage. Now comes the question of interpretation. Let us take an example. Suppose we may find that the lower end of the radius is not yet united. We ask when is this going to be united? It may be one to four years before it is united. There is no fixed standard. A girl may be one or two years younger or older than another girl whose bone presents the same x-ray appearance. It has been suggested that the conditions of endocrine balance created by a super-abundance of ultra-violet radiation and warmth tend to produce a condition whereby a greater proportion of the calcium intake is assimilated and made available for the formation of bone tissue. The same conditions of ultra-violet radiation and warmth of different quantity also affect the formation of bones. Also the normal endocrine balance, if upset by pathological states, can produce remarkable variation from the normal rate of formation and union of bony centres. Hence the age we give is only approximate and the mistake may be anything between one to three years if the opinion is based on the bones only.

I may mention here two cases in point. First, a man aged 32 had all the appearances, physical and radiological, of a boy 12 to 14 years of age. Second, a man aged 20 had the appearance and radiological characteristic of a boy of 12.

VII. *Degenerative changes*.—Namely, wrinkles, grey hair, arcus senilis, etc. These, as you know, are useless for our purpose. I have seen comparatively young fellows with grey hair and wrinkles, and I know a man who is only about 38 and has got an arcus senilis.

#### Conclusion

I will sum up by saying that the various data we have are useless, *if taken individually*, but when considered together and backed by experience of the examiner we can give a fairly approximate idea of the age of the individual, the mistake being only about 6 months this or other side of the real age.

I give here some of the bones and the ages of their union. If only these are x-rayed and taken into consideration it ought to be enough for our purpose.

| Name of bone | Part of bone      | FUSION OF THE EPIPHYSES |         |        |
|--------------|-------------------|-------------------------|---------|--------|
|              |                   | Earliest                | Average | Latest |
| Humerus ..   | Upper end         | 14                      | 14-16   | 18     |
|              | Lower end         | 11                      | 12-13   | 14     |
| Radius ..    | Upper end         | 12                      | 14      | 15     |
|              | Lower end         | 12                      | 16-17   | 18     |
| Ulna ..      | Upper end         | 12                      | 15      | 16     |
|              | Lower end         | 14                      | 16-17   | 18     |
| Carpal bones | Capitate          | 6 months.               |         |        |
|              | Hamate            | 8 to 14 months.         |         |        |
|              | Triquetrum        | 2 to 3 years.           |         |        |
|              | Lunate            | 5 years.                |         |        |
|              | Multangular majus | 5 to 6 years.           |         |        |
|              | Scaphoid          | 6 years.                |         |        |
| Metacarpals  | Pisiform          | 9 to 12 years.          |         |        |
|              | 1st               | 13                      | 14-16   | 18     |
| "            | 2nd to the 5th    |                         | 14-15   |        |

## A Mirror of Hospital Practice

### A CASE OF PULMONARY MYIASIS ?

By D. H. BHATT, M.B., B.S. (Bom.)

Assistant Surgeon, In-Charge Vadali Dispensary

On 10th November, 1941, a man was brought to the dispensary for treatment. He complained of fever, difficulty in breathing and occasional bleeding from the nose of dark red blood, and stated that small blood clots had been coming out, on blowing the nose, for the last three days.

The skin over the nose and upper lip was inflamed and swollen, the lower eyelids were oedematous, teeth were dirty and carious, the nares were a little larger than normal, and breath was foul smelling. On further inquiry the patient stated that his mouth always remained a little open during sleep.

On closely looking into the nostrils white dots—the terminal ends of the larvæ embedded in the submucous tissue—were seen.

The features of the case were typical of nasal myiasis. The patient stated that a couple of 'worms' had dropped out of his nose in the last two days.

The treatment—instillation of turpentine—was resorted to, and tinctura ferri perchloridi was painted on the inflamed parts. A few larvæ about 1 cm. long and 2 mm. broad, resembling a screw were picked out every day. For three days the above treatment was continued without any relief to the patient and the infection extended to the frontal sinuses. This was apparent from the skin in that region becoming inflamed and swollen and the upper eyelids oedematous.

As this subject has never been satisfactorily dealt with in the literature, there being no definite line of treatment I decided to use a mixture of creosote, beechwood oil and oil eucalyptus in equal parts instead of turpentine and I sprayed it in the nostrils with a De Vilbiss atomizer.



This mixture was irritating to the larvæ which were wriggling after the spray and it was easy to dislodge and remove them. This new mixture also stimulated coughing and the patient coughed out a couple of larvæ coated in sputum which was blackish. This led me to spray again until the patient had another spasm of coughing and eventually two more larvæ came out covered in sputum. The same evening (the spray was used twice a day) the patient stated that he had had a very troublesome cough throughout the day and about fifty worms were expelled mixed with sputum, besides some escaping from the nose.

This encouraged me to continue this treatment with addition of *tinctura iodi mitis* 0.5 c.cm. intravenously and seven and a half grains of sulphaniilamide (P. D. & Co.) *t.d.s.* The injection was repeated on the fourth day.

With this line of treatment about 60 to 80 larvæ a day were coughed up for three days. Then the number gradually dwindled with steady improvement in the patient's condition. By the end of the week he was completely free from the disease.

From the beginning of this illness the patient had used *neem*-vapour inhalations—*neem* bark and *neem* leaves boiled with water and the steam coming therefrom inhaled—which were continued throughout the course of treatment.

During convalescence cod-liver oil mixture was administered.

### Comments

Passing remarks have been found in the textbooks on the destructive activities of this type of parasite on subcutaneous tissues and bones, and meningitis is mentioned as a possible complication.

Mention of intestinal myiasis as a separate entity is also found, but nowhere is pulmonary myiasis mentioned as a separate entity or as a complication of nasal myiasis.

The following possibilities are of interest:—

Can the above case be considered one of pulmonary myiasis? Is it a complication of nasal myiasis? But this is unlikely because the patient never experienced any sensation or discomfort which he should have had during the passage of the parasites from the nose down through the larynx and trachea to the lungs.

Did the infection start simultaneously in two regions because the eggs of the responsible flies laid in the nostrils were inhaled and carried to the lungs?

[Note.—This is a clear case of nasal myiasis probably caused by *Chrysomya bezziana*. Though Patton has laid considerable stress on the destructive action of their larvæ on soft tissues and bones as well, Strickland and Roy have recently reported that even in cases of infestation by biontophagous larvæ, generally no particular symptom is produced. Although some protease is normally excreted by larvæ with their faeces, it is extremely doubtful if it is qualitatively and quantitatively strong enough to act on healthy tissues, whether soft or hard.

Regarding treatment, it may be stated that it is not easy to dislodge first- and second-stage larvæ from wounds but when they are mature, there is a natural tendency for them to leave the wound and drop on the ground for pupation. At this stage there is, generally speaking, a rapid response to local treatment whatever may be selected for this purpose.—EDITOR, I. M. G.]

## TRANSPPOSITION OF HEART AND VISCERA

By K. P. ABDUL KHADER, D.M.S.  
S. I. Railway Hospital, Trichinopoly

A MAN aged 25 years.

Occupation: Fireman, Trichinopoly Junction.

Chief complaint: Vague pain in front of chest. He stated he has had similar pain on previous occasions.

Duration: Three to four days.

Present history: The onset was sudden. The patient noticed one morning some vague pain in front of his chest and it grew in intensity and hence he sought medical aid at the hospital.

Previous history: Nothing of interest.

General examination: A well-built man of about 25 years; not anæmic; no clubbing of fingers or toes; no stunted growth.

Systematic examination: Temperature normal. Pulse rate 75, regular, full and bounding.

Cardiac system—contour of chest normal.

(a) Inspection: Apex beat visible in the fifth right intercostal space  $\frac{1}{2}$  inch below and  $\frac{3}{4}$  inch medial to the right nipple.

(b) Palpation: Apex beat in the right fifth intercostal space.

(c) On percussion, the borders of the heart were:—Right—1 inch lateral to right nipple line. Left—1½ inches medial to left nipple line.

(d) Auscultation: Heart beat, well audible in the fifth intercostal area on the right side, no murmur; both sounds audible, rate normal, no accentuation.

Blood pressure: 100/65 (sitting).

Respiratory system: Normal.

Digestive system: (a) Inspection: Abdomen normal, moves with respiration; no distension.

(b) Palpation: Liver and spleen not palpable.

(c) Percussion: Liver dullness elicited on the left side corresponds to that usually found on the right side in a normal individual.

Nervous system: Normal.

Diagnosis.—Clinically a case of dextro-cardia with complete transposition of all abdominal viscera.

The pain which the patient complained of was of muscular origin only with no relationship to his developmental condition. His pain disappeared after 2 to 3 days of routine treatment with soda salicylas mixture and he was discharged cured.

Skiagraphy.—The diagnosis was confirmed by x-ray picture of the heart, and the barium-meal fluoroscopy of the gastro-intestinal tract revealed complete transposition of the abdominal viscera with normal motility and otherwise normal function.

Discussion.—In this case, the patient was leading an active and normal life without any outward symptoms; the case being found out during the routine examination.

Apart from the anatomical curiosity, the rarity of such cases is considered to justify its publication as it is the only case of dextro-cardia we have seen in the course of handling a large labour force.

### Acknowledgment

My thanks are due to Dr. Jas. K. Manson, Chief Medical Officer, South Indian Railway, Trichinopoly,

for his assistance which enabled me to come to a conclusive diagnosis and for his permission to report this case.

## PROLAPSE OF RECTUM CAUSED BY VESICAL CALCULUS

By G. C. PATTANAYAK, M.B., B.S., D.T.M.

*Orissa Medical Service, Kendrapara*

A MIDDLE AGED labourer was admitted into hospital for prolapse of the rectum about 4 inches in length, with discharge of mucus, tenesmus and incontinence of urine for the past 1½ years. His main complaint was the continuous dribbling of urine. A tentative diagnosis of chronic bacillary dysentery, which had caused the rectal prolapse, and a reflex irritation of the bladder causing incontinence was made. Prolapse was easily reduced and rectal lavage with warm saline was given. The prolapse recurred as easily as it was reduced. Rectal lavage and rest having produced no effect, the bladder was examined with metal sounds and a fairly large vesical calculus was sounded. A rubber catheter could not be introduced for bladder washing. Any attempt at introducing irrigating fluid into the bladder immediately produced an involuntary straining and rectal prolapse. Rectal examination was very difficult, due to reflex straining.

Suprapubic cystotomy was performed and a large stone was taken out with difficulty. No cystitis being found, the wounds in the bladder wall and the parietes were sutured, with a small drainage tube under the skin. The patient made an uneventful recovery. There was no further recurrence of rectal prolapse.

*The calculus.*—The stone was phosphatic in nature and oval in shape. It measured 2 inches from tip to tip; 4 inches in circumference in the middle, and 5 inches in the tip to tip circumference. It weighed 105.5 drachms.

*Discussion.*—The calculus being large, it probably occupied almost the whole of the bladder cavity and no urine could be retained, causing the continuous dribble of urine. It also pressed upon the rectum. The straining for urination caused rectal straining for a long period. Continued straining for urination and the reflex straining of the rectum at the same time favoured the prolapse. When the original cause, namely, the stone was removed, the rectal prolapse was cured.

## A CASE OF MENSTRUATION THROUGH THE UMBILICUS AS WELL AS PER VAGINAM

By SRI. A. G. PEREIRA, L.M. & S.

*District Medical Officer, Coimbatore*

A FEMALE Hindu, aged 28 years, was admitted into the Government Headquarters Hospital, Coimbatore, on 8th January, 1942, with the following complaints:—

For the last one year she was having pain in the lower part of the abdomen, and during the menstrual period the pain increased and she was passing blood through the umbilicus as well as per vaginam. She had also vomiting, on and off, for the last two months.

*Previous history.*—She had two children; the first was a forceps case and the child died; the second was a Caesarean section about 7 years ago and this child died after 5 months.

Her periods were regular.

On superficial examination there was the scar of the Caesarean section (lower median incision extending beyond the umbilicus on its right side). There were a few pin-point holes in the umbilicus but no probe could be passed. On vaginal examination the uterus was ante-verted, fornices very tender, but no mass was felt. There was tenderness in the appendicular region. On barium-meal examination nothing characteristic was noted.

On 8th February laparotomy was done. The uterus was found connected by a strong band to a loop of small intestine and from a little beyond this attachment a fairly big sized mesenteric band was connecting with the peritoneal surface of the umbilicus. The uterus was also adherent to the anterior abdominal wall. The band connecting the uterus to the intestine was divided at both the extremities. The band connecting the intestine to the umbilicus was also divided between the ligatures. The raw surface under the umbilicus was obliterated by bringing together the peritoneum on both sides.

She had an uneventful convalescence. Sutures were removed on the 10th. On the 25th February she had her periods through the normal passage, and was discharged cured on 3rd March.

## A CASE OF GIARDIASIS

By H. S. ANDLEIGH, B.Sc., M.B., B.S., D.T.M.

*Resident Pathologist, Medical College, Agra*

R. S., Hindu, male, aged 30 years, was admitted into the medical wards of the hospital on 5th March, 1942, for the following complaints:—

- (1) Passage of mucus with stools.
- (2) Constipation.
- (3) Marked loss of weight—30 pounds in 1½ years.
- (4) Abdominal discomfort, specially below the umbilicus.
- (5) Gurgling in the lower abdomen.

All the symptoms were for about 1½ years.

Towards the end of the year 1940, he was stationed in a rural development dispensary in the district of Budaun, U. P. Once while on tour, he was by chance detained in a small village situated between the two currents of the river Ganges. There he had to depend upon the Ganges water for drinking purposes. He stayed there for three days and when he returned to his station, he felt a severe heaviness in his stomach with gradual and progressive constipation and loss of appetite. This condition continued for about a week when the constipation became very obstinate. He took a dose of saline which resulted in 3 to 4 motions. This purgation was followed by severe colicky pain which had to be relieved by two doses of atropine and morphine. This was followed by a period of quiescence of symptoms for about six months, except for mild abdominal pain and loss of appetite. He again got severely constipated for which he took a dose of castor oil, which resulted in several stools with large amounts of mucus, and were followed by a severe type of abdominal pain. This happened in the month of February 1941 and since then the passage of mucus with stools has been continuous. It increases now and then to a large amount. His stools were examined

twice in the month of April, but nothing abnormal was reported. As he was rapidly losing weight, he got himself admitted to the Thomason Hospital for systematic investigation and treatment. I examined his stool here and found it full of cysts of *Giardia intestinalis*. Other examinations carried out here were as follows:—

(1) Opaque enema—caecum and ascending colon have irregular outline and general mottling; no meal in the ileum.

(2) Gastric analysis—free HCl and total acid within normal limits.

(3) Sigmoidoscopic examination—nothing abnormal found.

(4) Blood picture showed only a slight degree of anaemia.

He was given a course of atabrin tablets, one tablet thrice a day for 5 days.

I again examined his stools on 17th March, and found no cysts of *Giardia intestinalis*. There was also no mucus in the stools. He has been relieved completely of his symptoms. His appetite has increased and he is no more passing any mucus with his stools. He has already started feeling much better and is gaining in weight; and I hope he is completely cured.

My thanks are due to Dr. G. N. Vyas, M.D., M.R.C.P., professor of medicine, for allowing me to report this case.

## A CASE OF TETANUS

By MOHAMMED ASGHAR FAROOKI,  
M.B., B.S. (Pb.)

School Medical Officer, Sialkot City

M. B., Muslim female, aged 25 years, wife of a doctor and sister of a doctor, on my friendly visit to her family on 6th April, 1942, told me that she had been having a slight temperature between 99° and 100°F. for four days. She had no other complaint except a little pain in the abdomen, especially in both sub-costal regions. I told her not to worry, thinking that it was only an attack of sandfly fever.

The same midnight she woke up with a terrible pain in the abdomen under both costal margins and could not sleep. She was given potassium bromide, grains 15, followed by luminal grain 1/2, half an hour later, with no effect. An hour later, she was given morphia grain 1/6 and atropine grain 1/100 subcutaneously as a result of which she slept quietly.

7th April.—She was sleeping till late morning and was awakened with difficulty; she was quiet and drowsy, and answered questions slowly. Cold sponging of the face brought about only a little improvement. The pupils were normal and reacting to light. It was thought that this sleepy condition might be due to morphia and would pass off soon. For the little distension she had, she was given glycerine enema, pituitrin, and flatus tube with good effect. At noon she became stuporose and developed lock-jaw. Previous history and examination of the patient revealed no wound, injury or scratch on the body. She had been delivered of a male child three months back, by a dirty *dai* before the lady health visitor could arrive. In the afternoon she was absolutely unconscious. We were still pondering over the co-existence of lock-jaw and unconsciousness, when she got her first typical tetanic convulsion, followed by another in a few seconds. There was convulsion of the whole body with cyanosis, foaming in the mouth, *risus sardonicus* and opisthotonos.

Anti-tetanic serum was given immediately, 30,000 international units intravenously and 30,000 international units intramuscularly. Lumbar puncture was tried but could not be done, due to severe opisthotonos and the parents did not like resorting to chloroform anaesthesia. Other general treatment was given in the shape of exclusion of foreign stimuli. Her temperature was 99°F., pulse 96, and respiration 24 per minute. Chloral hydrate, grains 30 and potassium bromide, grains 60, were given per rectum, which controlled the spasms in number and severity. We did not like to give more hypnotics, as by now the pupillary reflex had completely disappeared.

8th April.—Patient was still unconscious with no corneal reflex and no pupillary reaction. Feeble tetanic convulsions appeared occasionally. Temperature shot up to 104°F., pulse 122 and respiration 28 per minute. Hydrotherapy was done, which lowered the temperature to 101°F. Anti-tetanic serum, 15,000 international units was given intravenously and 5,000 international units intramuscularly. Ten c.cm. of 20 per cent magnesium sulphate solution, 25 c.cm. of 25 per cent glucose, and 5 c.cm. of 10 per cent soluseptasine, were given intravenously and were repeated six hourly. At noon she again developed severe convulsions (in spite of the deep coma she was in) which were controlled by morphia grain 1/6, hyoscine grain 1/100 and atropine grain 1/100 hypodermically. Respiration was quiet till evening when it became periodic and failing. All hopes were lost. In a desperate attempt to keep up the respiration, 3.4 c.cm. of coramine intravenously and 1.7 c.cm. intramuscularly were given. The improvement was marked and the respiration became normal in 15 minutes. Paraldehyde 2 drachms and ether 1 drachm in 3 ounces of olive oil were given per rectum at night, and there was no necessity to repeat it afterwards.

9th April.—The respiration was quiet, smooth and 26 per minute, pulse 140 per minute, and temperature 101°F. The heart sounds were weak and first sound softened. Digitalin grain 1/100 was given, anti-tetanic serum 20,000 units intravenously, soluseptasine and glucose were continued as before. Glucose saline per rectum was also given four hourly. The patient was still deeply comatose. Convulsions still appeared though mild. She died that evening as a result of circulatory failure.

### Points of interest

1. Tetanus developed in a woman three months after delivery and there was no discharge per vaginam.
2. Although the incubation period was prolonged to as much as three months, the disease itself was of a very fulminating type.
3. Pain under both costal margins was probably due to irregular spasms of the diaphragm and appeared many hours before lock-jaw.
4. The mind was peculiarly cloudy to start with, but this soon passed into coma and she remained so throughout the course of the disease.
5. Coramine was most efficient in controlling respiratory failure.
6. Death was due to circulatory failure and exhaustion.

My grateful thanks are due to Dr. C. L. Sahni, M.B., D.P.H., D.T.M. & H., municipal medical officer of health, Sialkot city, for kindly allowing me to report this case.

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## AMOEBIASIS SINE DYSENTERY

THE word amoebiasis was used by some of the earliest investigators on amoebic dysentery—and it is usually attributed to Clegg and Musgrave—but it is only during the last twenty years, during the inter-war period, that it has come into common use, and that the general practitioner has become conscious of the potentialities of amoebiasis *sine* dysentery.

Let us consider what are the facts and what are the theoretical deductions regarding *Entamoeba histolytica* and the lesions it produces.

(i) In the first place, its pathogenicity has been established beyond reasonable doubt; the trophozoite forms of the amoeba are shown to be parasitic, and to ingest red blood and other tissue cells; these trophozoite forms are found buried in the tissues of the walls and bases of the ulcers, they are often the only living organisms in a liver abscess, and, whilst they are still there, the ulcers will not heal. Therapeutically, it has been shown that emetine has a direct action on these amoebae, that when this drug is given parenterally to an infected person it acts on the amoebae in the tissues and destroys them, and that in patients so treated the ulcers heal. Experimentally, the amoebic infection has been transmitted to man and certain animals, and typical lesions, from which the amoeba have been recovered, have been produced, whereas it has been shown that in similar circumstances *Entamoeba coli* will not produce ulceration of the colon.

(ii) Amoebic dysentery, together with its most serious complication, liver abscess, is a tropical and sub-tropical disease. Many cases have been reported amongst returned sojourners in the tropics and amongst their close associates in their homes in temperate countries, but very few instances of locally acquired sporadic amoebic dysentery or liver abscess ever occur in temperate countries, and, when they do, they are usually considered worthy of separate report in the medical press.

(iii) We know that minute ulcers may be present in the colon in the absence of clinical dysentery, or even of any other symptoms referable to the bowel. In these cases, *Entamoeba histolytica* cysts will be passed in the stools, and active amoeba will be found in the ulcers. There is considerable evidence that, although these ulcers may not produce dysenteric symptoms, they allow the entry of bacteria and/or of unchanged or partially-digested food substances directly into the blood stream, and thereby cause septic and/or allergic disease.

The evidence in favour of this sequence of events gains much support from the fact that the administration of amoebicidal specifics will cause the disappearance of both the cysts from the stools and the patients' symptoms.

(iv) Emetine given parenterally will usually cure amoebic hepatitis dramatically and will arrest the process of abscess formation; it will also cut short the dysenteric process in its early stages, but in the later stages, when the patient is passing cysts only and also in the carrier, oral administration of emetine bismuth iodide, or other amoebicidal drugs, such as yatren or carbarsone, are usually considered to be necessary to eradicate the infection.

(v) *Entamoeba histolytica* produces cyst forms that are now distinguishable by certain definite criteria from other non-pathogenic amoebae that inhabit the intestinal tract of man.

(vi) World-wide investigations during the last twenty years have shown that not only do a large percentage of the inhabitants of the tropics and sub-tropics, and of soldiers and others who have returned from the tropics and sub-tropics, pass *E. histolytica* cysts in their stools, but that a considerable percentage of residents of temperate climates, Great Britain, Canada, and the United States, also pass morphologically identical cysts in their stools; in the last group, the percentage is variable and varies according to the degree of sanitary advancement of the area and of the community from which the individuals are drawn.

Faust (*Amer. J. Trop. Med.*, **22**, 93) has suggested that in the United States, on an average, 20 per cent of the population pass *E. histolytica* cysts in their stools.

So much for the facts: now it has been deduced from the above facts and other evidence that *Entamoeba histolytica* is an obligatory parasite, that the presence of *Entamoeba histolytica* cysts in the stools of an individual is definite evidence that that individual has small ulcers in his or her colon which are potential, if not actual, portals of entry for bacteria and/or allergens, that such persons are a potential danger to others and should never be employed as food handlers, and that they are themselves liable to suffer from the innumerable ills that have been attributed to these small ulcers, and also that if their resistance is lowered they may suddenly become victims of frank amoebic dysentery, and that they should therefore undergo a course of treatment for eradication of this infection.

How do these facts and deductions tally? We will first consider the last of the facts. What is the evidence that one in every five residents of the United States has small ulcers in his or her bowel mucosa? How often have these small ulcers been seen in the tens of thousands of *post-mortem* examinations that are performed annually in that country? It is suggested that these ulcers are very small and superficial and heal rapidly; even then they should be found quite frequently.

Then the question arises, why, once having obtained a footing, should the amœbæ be so rapidly overcome by the local tissue resistance? Is it a matter of individual susceptibility? We can understand how in one person only small superficial ulcers are found, in another extensive ulceration, and in yet others the amœbæ reach the liver and cause hepatitis in one case and liver abscess in another, but why in one country should all individuals enjoy a high degree of immunity whereas in another they enjoy a varying amount? Is it a matter of racial immunity, or of the climatic factor? If the former, why does this immunity break down so readily when the same individuals go to the tropics, or in either case how can one explain the Chicago outbreak of 1933?

In this incident, 1,400 people, who had stayed in Chicago at one or other of two hotels which had a common water-supply that was later shown to be badly contaminated, developed acute amœbic dysentery and about 70 of them died. What suddenly happened to the immunity in these 1,400 people? And why if 1 in 5 of them already had a *histolytica* infection, was this super-infection from the water-supply necessary to precipitate an acute dysenteric attack?

Why under the various strains and stresses that man is subjected to does the resistance of these so-called *histolytica* 'carriers' practically never break down in temperate countries and produce frank dysentery and/or liver abscess? Even if we depart from the teaching of the protozoologist, and assume that *E. histolytica* can sometimes live as a saprophyte in the intestine of man, we still want to know what determines its invasiveness.

It is not clear why, if emetine given parentally will destroy the amœba in the ulcers in a case of frank amœbic dysentery, it will not also destroy the amœbæ in the small ulcers in the carrier, and thus prevent the formation of cysts, and/or how drugs, such as carbarsone and yatren, which are designed to act on the pre-cysts forms of amœbæ in the lumen of the gut, also destroy the parent amœba buried in the tissues and thereby prevent further cyst formation; in the latter case, it is probable that they are absorbed and act *via* the blood stream just as emetine does, but, if this is so, why should they not then be equally efficacious in acute amœbic dysentery and in amœbic hepatitis; in the latter, they are certainly not.

Thus, the story as it is told in the textbooks to-day does not apparently present the whole truth. How can these apparent inconsistencies be reconciled?

One rather revolutionary suggestion is that the amœba is not the true causative organism, but only a secondary invader. This can, we think, be negatived, not only by the pathological evidence and the experimental work that has been done with this organism, but by the fact that so much ulceration of the bowel occurs on

to which the ubiquitous amœba does not become engrafted.

Another suggestion is that a normally saprophytic amœba is stimulated in some way to become pathogenic, possibly by the synergistic action of some other micro-organism. There is, as far as we know, no experimental evidence in favour of this, but the ubiquity of the amœba and the limited distribution of amœbic dysentery could be explained on these grounds.

Finally, is it possible that we have accepted too readily the majority protozoological opinion regarding the identity of the cyst that is found in 1 in 5 of the stools of the inhabitants of the United States with the pathogenic *Entamœba histolytica* that causes amœbic dysentery and liver abscess in the tropics? The evidence is mainly morphological, but how far can we trust morphology? Confusion has reigned in the epidemiology of cholera until quite recently through failure to identify the true cholera vibrio; we might well be faced by a parallel position here. Many of the apparent anomalies could be explained on the assumption that there is a non-pathogenic race of amœbæ which produces cysts morphologically identical with those of the true pathogenic *Entamœba histolytica*, and that in the tropics we have both, whereas in temperate countries only the former is normally prevalent, although the latter may occasionally appear, e.g. the Chicago incident. At least, we feel, it is time that the subject was re-examined by the protozoologist.

The subject is one of much more than academic interest; in fact, it is one of vital importance to the clinician, for the list of diseases that are attributed to amœbiasis *sine* dysentery is already formidable and continues to grow. It includes all allergic diseases, many skin diseases, both allergic and septic, many chronic eye diseases and in fact the whole range of diseases in which a 'septic focus' is suspected as an ætiological factor. The physician who is groping about blindly for an allergen or septic focus finds the stool examination an easy and inexpensive procedure, and if his patient happens to be one of the 1 in 4 who passes *E. histolytica* cysts in this country (the incidence is higher than in the U.S.A.), he has found something positive and he either recommends a course of carbarsone or yatren, or ignoring modern teaching—or perhaps, questioning it as we have done above—he gives his patient six or more emetine injections—often, we fear, neglecting to warn him to rest during this treatment—or to make assurance doubly sure, he prescribes the double treatment. Now and then, this procedure, which is a perfectly rational interpretation of the amœbiasis-*sine*-dysentery hypothesis, appears to be brilliantly successful, for in this country we know that the dysentery-and-liver-abscess-producing *Entamœba histolytica* is prevalent and there is no question also that emetine has a non-specific beneficial action in hepatitis, but how often does

it make not the slightest difference to a patient? In view of the high incidence of these cyst passers amongst the apparently healthy members of the community, have we any right to attribute so much ill to these cysts, or rather to their parent amœbæ, and to waste valuable drugs—of which an acute shortage is threatened—without more clinical evidence that they are indicated?

The pathologist complains quite rightly that the physician does not take full advantage of

laboratory science and, for example, treats all anæmias with liver extract when 75 per cent of them would do much better with the far cheaper iron, but he should be sure that he himself does not sometimes mislead the physician into practising a pseudo-scientific quackery. In the matter of the significance of *E. histolytica* cysts, we feel that he cannot be too certain, and we therefore issue a plea for the re-examination of the whole subject, and for further experimental work if necessary.

## Special Article

### ALCOHOLIC BEVERAGES IN INDIA

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#### PART III

#### *Physiological action of alcohol*

ALCOHOL has the peculiarity of being absorbed from the stomach in considerable quantities. After administration of ordinary doses as much as 25 per cent is taken up from the stomach and the balance is absorbed from the upper part of the small intestines. It appears in the blood in 5 minutes after it is taken by the mouth, its concentration reaching the maximum in about 1½ hours and then slowly declining. The maximum concentration in the blood is somewhat higher than in other tissues. Even the kidneys have not the power of concentrating alcohol as its percentage in urine is about the same as that in venous blood. In those who are accustomed to its use nearly the whole quantity taken is broken up by the tissues, only about 2 per cent usually being excreted by the breath and urine, and not more than 10 per cent in any case. Concentration of alcohol in the blood can be approximately calculated by dividing the quantity absorbed, by the body weight. Strong alcoholic drinks produce somewhat higher concentration in the blood than diluted drinks. A concentration of 0.055 per cent in blood produces slight mental disturbance; marked symptoms appear even in habitual drunkards when the concentration reaches 0.25 per cent.

According to Clark (1937) 0.025 to 0.1 c.cm. in 100 c.cm. of blood produces euphoria, impaired speed and inaccuracy; 0.1–0.2 produces disorder of conduct, minor inaccuracies and slowing down of movement; 0.2–0.5 appeared to produce intoxication, coma and gross inaccuracy of motor reactions.

Tolerance to alcohol in those habituated to its use is due to tolerance in the central nervous system. It is feebleness than that produced by other drugs. That the brain functions are modified in alcoholics is shown by the fact that sudden stopping in such individuals leads to delirium tremens, which is then checked by moderate doses of alcohol. The gastric mucosa and the liver do not acquire tolerance but undergo progressive degeneration. In chronic alcoholism all the body tissues are devitalized and the will power, moral sense and mental capacity are greatly impaired.

Two of the commoner fallacies that need to be discussed under this heading are the use of alcohol

as (a) a stimulant and (b) a warming agent of the blood and tissues when taken after exposure to cold.

(a) *The use of alcohol as a stimulant.*—The popular belief pertaining to this particular effect of alcohol is precisely the opposite in its actual action. Alcohol acts primarily on the nervous system and its action is largely narcotic or sedative. The apparent stimulation is actually the direct effect of this narcotic which dulls the drinker's perception of his unpleasant feelings and makes him feel better. Effects such as increased loquacity and gesticulation, produced by alcohol, which are commonly attributed to its stimulant action, are also in reality narcotic effects resulting from the partial loss of the control exercised by the higher nervous centres. Ordinarily this control renders an individual self-critical and prevents him from the freer expression of his feelings. The removal of this control and the decrease of critical self-consciousness are, in fact, the most common and characteristic effects of alcohol, whether in a moderate dose, which diminishes restraint and 'nervousness' and imparts courage to the diffident speaker, or in larger doses when diffuse and inco-ordinated muscular movements of drunkenness are produced. The action of alcohol on the brain has been tested by a number of workers and they are all agreed that alcohol decreases the speed and accuracy of reflex response.

The popular belief that alcohol is a direct stimulant of the heart does not bear any scientific justification. Such value as it may have in heart diseases depends on its being a readily assimilable food, on its direct and reflex power to weaken the excessive check on the action of heart exercised by the nervous centres, and on its sedative influence on the higher centres of brain. The cumulative effect, inducing a sense of comfort and relief of mental anxiety, may be useful in selected cases of heart diseases, but it is actually the very opposite of stimulant effect. When an alcoholic drink appears to promote recovery from simple fainting it probably acts reflexly, like smelling salts, by virtue of its irritant effect upon the mucous membrane of the mouth and nose. Since the beneficial effect appears almost immediately and long before any appreciable amount of alcohol could have been absorbed and carried to the heart, the action must be local and indirect. The administering of spirits in the treatment of fits of unconsciousness is to be deprecated, for even in simple fainting alcohol is unlikely to do much good, and if the unconsciousness results from apoplexy or a head injury it may do positive harm.

The effect of alcohol on blood pressure is also of importance because of its supposed action as a circulatory stimulant. When administered by the mouth in concentrated form it stimulates the sensory nerve endings in the mouth and produces a reflex rise of blood pressure by exciting the vasomotor centre. After absorption, however, it produces dilatation of the blood vessels, particularly those of the vessels of the skin; this fact is probably due to its action on the heart-regulating centre, thus causing a lowering of the blood pressure.



(b) *The use of alcohol as a warming agent of the blood and tissues after an exposure to cold.*—Alcohol depresses the activity of the heart-regulating centres and therefore acts as an antipyretic. The temperature of a person under the effect of alcohol can be more easily lowered than that of a normal individual. It is probably owing to this effect on the heart centres that alcohol causes dilatation of blood vessels of the skin and a subjective feeling of warmth. It is therefore more inadvisable to take it either before or during exposure to severe cold because, although it produces a temporary feeling of warmth and comfort, it diminishes the power of the body to conserve heat.

Alcohol is popularly believed to have a warming action on the human system when it is taken after a chill. It is to be emphatically stated that the so-called 'warming up' action of alcohol is not a physiological process and the sensation of warmth it causes is purely due to the flushing of the skin surface. This flushing does undoubtedly lead to relief of the unpleasant sensation of 'feeling cold', but this may itself, in some cases, be disadvantageous for, under exposure to cold, the unpleasant sensation urges the individual to protect himself suitably and thus assists the maintenance of body temperature by creating an impulse towards muscular exertion, so that the production of heat is accelerated. These effects of alcohol also form a part of the explanation of its supposed therapeutic value when taken in early stages of a common cold, but it may also have a more definite pharmacological action in such cases by assisting in the diffusion of blood to the vessels of the skin and thereby relieving partially the congestion of the internal organs, as well as promoting respiration. It must, however, be recognized that against the symptomatic benefits that may be derived from taking alcohol when the patient is in a warm bed at the outset of a 'cold', alcohol when taken habitually in excess decreases the body resistance to bacterial infection.

*Pharmacological action of alcohol.*—Alcohol has a stimulant effect on the taste nerve-endings, increases the flow of saliva and stimulates the psychic secretion of gastric juice. Flavouring agents in alcoholic beverages such as bitters in beer and ethereal esters in spirits intensify these actions. Alcohol directly stimulates the functions of the stomach and in this way stimulates the secretion of gastric juice. Concentrated solutions of alcohol produce gastric irritation which, after a preliminary stimulation, lead to inhibition of secretion. Continued use of such drinks may produce chronic gastritis and total loss of acid from gastric juice.

The action of alcohol as a circulatory and respiratory stimulant is not powerful enough to be of any great therapeutic value.

*Alcohol as food.*—A large amount of experimental work has been done to show that the value of alcohol as food is very limited. It undoubtedly does enter the blood and is oxidized by the tissues at a constant rate, yielding energy, but the supply of energy is fixed and cannot be adjusted according to the needs of the body; it particularly cannot be increased to meet a sudden emergency nor can it be stored as a reserve. It also does not, unlike other foodstuffs, cause increase of basal metabolism.

*Alcoholism as a cause of neuritis and cirrhosis of liver.*—The researches of various American authors—Welsler, Minot, Strauss and Cobb, Joffe and Jolliffe and others—have shown that the form of peripheral neuritis which characteristically occurs in chronic alcoholics is not due, as was formerly supposed, to the toxic action of alcohol on the nerve tissues, but to the deficiency of the B vitamins, and especially of vitamin B<sub>1</sub>, in the diet of the alcoholic. 'Alcoholic neuritis' is to be regarded as a nutritional disorder closely related to beri-beri, the more acute manifestation of vitamin-B<sub>1</sub> deficiency, which is seen in certain tropical countries. There is some evidence also that other morbid effects of chronic alcoholism, notably the gastric changes and the 'alcoholic heart', may be due,

at least in part, to vitamin-B<sub>1</sub> deficiency. The action of alcohol in such cases is indirect rather than direct, but its rôle as an aetiological factor should not therefore be regarded as of small importance. The fact that the 'alcoholic' type of neuritis, and the related lesions, occur most frequently in chronic alcoholics cannot be disputed, and apart from their significance in regard to treatment, the main interest of the new findings lies in the light they shed on the actual method by which alcoholism may lead to harmful effects in the tissues. The process by which alcoholism may lead to vitamin-B<sub>1</sub> deficiency is still somewhat obscure; but among the factors responsible are probably decreased intake, due to the habitually poor appetite of the alcoholic, and to the fact that he can obtain his working energy from alcohol instead of from other foods, and possibly to increased utilization of the vitamin in such cases. The absorption of this vitamin may possibly be decreased on account of the catarrhal condition of the gastro-intestinal tract.

From the point of view of treatment, this new work has great value, for it has been shown that alcoholic neuritis formerly regarded as a very chronic and intractable disease, will in some cases respond quite rapidly to adequate doses of vitamin B.

Recent work has shown that cirrhosis of the liver is not due to the direct effect of alcohol on the parenchyma of the liver but it is in all probability due to its damaging effects on the intestinal mucosa, which leads to absorption of abnormal quantities of products of intestinal putrefaction.

*Alcohol in health.*—Taken in moderate quantities (e.g., a large peg of whisky or a pint of beer) alcohol acts as a mild hypnotic and therefore renders the brain less active and less accurate; this effect may last for several hours. It reduces the accuracy of movements and eventually increases fatigue and the power of prolonged endurance to severe muscular exertion is reduced. As a food it is inferior to carbohydrate and fats and is a very expensive source of energy.

The consumption of alcohol in Great Britain has decreased enormously during recent years. The annual consumption per head was 4.54 gallons in 1900 and the convictions for drunkenness were 200,000 annually. In 1930 these figures had fallen to 1.98 gallons per head and convictions to 53,000.

*Intoxicant effects of alcohol.*—According to Clark (1937) symptoms of slight intoxication, recognizable without any special tests, commence when the blood concentration reaches 0.1 per cent or 1 mg. per c.c.m. of blood or 0.125 per cent vol./vol. (as the specific gravity of alcohol is nearly 0.8). The quantity of alcohol needed to produce this result is shown in the following table (after Clark 1937):—

TABLE VII

| Drink                            | Concentration of alcohol per cent vol./vol. | Quantity supply 60 c.c.m. alcohol producing 1.0 mg. per c.c.m. concentration in 50 kilo. individual |
|----------------------------------|---|---|
| Whisky (35 degrees under proof). | 37  | 160 c.c.m. or 5 oz.   |
| Port .. ..                       | 2.0   | 300 c.c.m. or $\frac{1}{2}$ pint.   |
| Natural wines ..                 | 9-15  | 670-400 c.c.m. or 1 to $\frac{1}{2}$ pint.  |
| Strong beers ..                  | 7   | 8.50 c.c.m. or $1\frac{1}{2}$ pints.  |
| Light beers ..                   | 4-5   | 1,500 c.c.m. or $2\frac{1}{2}$ pints.   |

It will be seen from this that country beers, which contain even smaller percentages of alcohol, will require 4 or 5 pints to produce intoxicating effects (Clark, 1937). Alcohol even in sub-intoxicant doses is

probably one of the most important causes of motor accidents.

### *Are alcoholic beverages abused in India?*

**Country beers.** (a) *Tari*.—The harmful effects of the abuse of alcoholic beverages were realized from very early days. Tipu Sultan found drunkenness from *tari* so prevalent that he ordered all *tari* trees to be cut down. Sir Brown Ellis gave similar orders, for the same reason, with regard to date palm trees growing on the Government waste lands in Bombay Presidency. The Excise Commissioner in Bengal in 1884 found that much of the drunkenness attributed to outstills was really due to *tari*. Our own inquiries in parts of Bombay and Madras Presidencies, from old alcoholics, show that before the introduction of control, it was not uncommon to find the entire village, including men, women and children, drunk with *tari*. This state of affairs is sometimes met with even in these days in remote areas, in forests where Government control is not efficient, for instance, in the Agency Tracts of Madras, the Panch Mahals of Bombay and the areas inhabited by the Maria Gonds in the Chanda district of the Central Provinces. In certain parts of Bihar, which are populated by aborigines, and the mining areas of Bengal, there is a certain amount of difficulty in keeping women or servants sober.

(b) *Pachwai*.—Drunkenness due to drinking *pachwai*, which is a mild drink, also exists in certain parts of India. Some of the aboriginal races drink this beverage to a stage of intoxication, when they get an opportunity. Among the hill tribes in Chota Nagpur, Bengal and Assam there is a tendency to take large quantities of *pachwai* if it can be had ready-made in shops, but on account of the paucity of the supply of rice they do not manufacture it in their own homes. Drunkenness due to *pachwai* is not uncommon in the mining areas in Bengal and Bihar. The evidence in favour of *pachwai* being taken mostly for its nutritive effects is also not so strong as in the case of such beers as *zu* and *laopani*, as the rice in the former becomes unpalatable and bitter after fermentation, and is not consumed but thrown away.

Among the hill tribes in Assam the beers ordinarily consumed are weaker and the manner of their consumption is also different, the beverage being taken in the form of a thick gruel and rice eaten with it. It is a part of the dietary of the inhabitants of the whole range of hills right up to Tibet and Burma. These tribes, who have a fine physique and are hardy, use as much as 25 per cent of their rice crop for this purpose. This in itself is proof that this beer cannot be very harmful and probably is not abused. Drunkenness of a convivial nature, however, does occur among these tribes and many individuals may become incapacitated for days together after drinking bouts. Amongst the tea garden coolies the state of affairs is much worse and

there is considerable drunkenness from this source. The coolies get so accustomed to the use of beers that they will starve themselves in order to get rice for brewing *laopani* or *zu*. In the United Provinces the evidence we have collected goes to show that excessive use of beer and drunkenness is confined chiefly to festive occasions. In Jaunsar taluk *pachwai* and *rabra* are chiefly used on such occasions as New Year's Day, Dewali and certain other festivals. In the Punjab, although evidence of drunkenness and even of debauchery was produced before the Excise Committee, *lugri* drinking usually is only conducive to merry-making of a harmless type. In South India beers are used to a much smaller extent, there being only one or two small areas where they are still consumed.

It has sometimes been urged that the use of such beverages should be totally stopped. On the other hand, there are authorities who think that any attempt to restrict their production would do more harm than good and would encourage drinking of stronger liquors or the resort to narcotics such as opium or hemp. The use of beer to the extent of producing uncontrollable intoxication is rare. Repeated doses of these beverages in excess may produce a state of intoxication similar to that commonly produced by stronger forms of alcoholic drinks. The accompanying recklessness of danger and the feeling of bravery induced in such cases is partly the result of the temperament of these more or less primitive races, and also in many cases it is due to a state of mental confusion induced by poisons such as *dhatura*, *aconite* and *nux vomica* with which the beers are not infrequently adulterated.

There is no doubt, however, that in a few instances drinkers of country beer intoxicate themselves, simply for the purpose of inducing a state of intoxication. These gross instances of producing motiveless drunkenness from country beer corresponding to the excessive drinkers of alcohol in the West; they are fortunately not common. Very large quantities have to be taken before such a condition can be produced, and this is often beyond the means of the drinkers.

### *Effects of different alcoholic beverages*

We have analyzed the statements of individuals who were in the habit of regularly taking different forms of alcoholic beverages as to whether their general health was improved after their use or not. The following observations summarize the views expressed :—

(A) *Effects of tari*.—Over six hundred cases were examined in different parts of the country, taking different quantities of this beverage in different stages of fermentation. It was found that the intoxicating effects of *tari* were comparatively mild and that in 80 per cent of this series the stage of intoxication, if it occurred at all, lasted only for short periods not exceeding half an hour. The remaining 20 per cent (some

of them being very reliable persons holding responsible positions) stated that the beverage had no intoxicating effect at all and that it was a wholesome, refreshing and invigorating beverage with marked nutritive properties. They believed it to be the least harmful of all the alcoholic beverages used in this country. Owing to divergence of opinion we decided to go into this question in more detail.

The term *tari* includes both the unfermented and fermented juice of all kinds of palm tree. According to an analysis carried out in the laboratories of the Bengal Government, its ordinary strength was found to be about 95°U.P., which can be compared to the weakest description of *vin ordinaire*. The Excise Commissioner of the United Provinces puts its strength at 98.1°U.P., and another authority repeats the assertion once made in the House of Commons that it is little stronger than home-made ginger beer. It must be presumed that in *tari*, fermentation sets in rapidly because the solution is favourable for fermentation and the pot in which the juice is collected is almost invariably coated with fermenting material. The rate of progress of fermentation varies according to the kind of palm tree tapped and the temperature at which it is kept. For instance, in cooler climates, the alcoholic content may be negligible or entirely absent after a few hours; while in warmer climates fermentation occurs rapidly, unless certain chemicals are used to prevent it, the most common method being coating the inside of the pot with lime. If the alcoholic content is low, the percentage of unfermented sugars is high, and vice versa. It appears, therefore, that opinions regarding the harmlessness of fresh *tari* are justified, so far as they relate to *tari* in which the fermentation has not commenced or has only slightly advanced. In the authors' opinion they relate to only 30 per cent of the cases examined, in the remaining 70 per cent careful enquiry showed that fermentation was far advanced or nearly complete. A series of analyses of these specimens of *tari* showed that the average strength in Bengal and Madras was 89.20 U.P., which compares well with almost all mild alcoholic beverages used in the West.

As regards the effects of other harmful ingredients, it was found that the ordinary *tari* consumed in shops contained, bulk for bulk, nearly the same proportion of fusel oil as an equal amount of spirit of 60 U.P.; this is nearly four times as much in proportion to the alcohol content. Besides alcohol these specimens contained a large proportion of acids, which are believed to be the chief cause of indigestion, diarrhoea, dysentery and rheumatism which accompany its excessive use. As regards their nutritive value, these specimens contained a fair amount of sugars and albuminoids. It would appear, therefore, that *tari* on the whole has low alcoholic content, and comparatively greater nutritive value than many of the other alcoholic

beverages in use. The nutritive value, however, is of importance only in the case of moderate consumers of this beverage, who take it in a comparatively fresh state. When it is taken in large quantities, the percentage of some of the impurities consumed is much greater than would be the case if the same amount of alcohol was taken in the form of distilled liquors. It should be remembered that the nutritive factors are of little advantage to the consumer, who drinks in order to get drunk, and that large quantities of *tari* consumed have injurious effects. There is a popular saying that the confirmed *toddy* drinker soaks, he becomes bloated and lethargic, while the drinker of country liquor is soon under the effect of alcohol. There is moreover a large amount of medical and other evidence on record to show that considerable injury results from drinking of stale *tari*, which is described not only as a powerful intoxicant but, on account of its acid content, as highly productive of such metabolic disorders as gout, and is detrimental to health in other ways. Thus from observations in the field extending over prolonged periods in different parts of India, we are inclined to believe that the unfermented *tari* is the least harmful of all the beverages consumed in this country. If its use is in any way restricted, we have no doubt that people will be driven to more harmful beverages. In moderate quantities there is little harm; excessive drinking is very detrimental to health.

(B) *Effects of country beers (fermented beverage).*—There is a great deal of difference of opinion as to whether country beers are wholesome or harmful. The effects produced by them are somewhat similar to those of ordinary malt beer, commonly used in the West. The immediate effects in habitual consumers are refreshing and stimulating; they alleviate fatigue and give rise to a sense of pleasure and general comfort (euphoria), accompanied by a feeling of vigour, and capacity for work. According to those who take them habitually, these beers remove restlessness, induce forgetfulness and soothe the nerves. Drinkers are at first inclined to be silent, but they soon begin to talk, become happy, courageous and even hilarious. They become sociable, the eyes brighten up and the usual depressing effects of alcohol on the higher centres become apparent. With larger doses the symptoms observed are similar to those seen after strong alcoholic drinks. As regards the production of harmful effects with these beers, our experience is very much the same as that of the witnesses who appeared before the Indian Excise Committee. These liquors are not always innocuous and sustaining as is sometimes claimed, and they undoubtedly lead to much waste of food material. Cases of excessive drinking are not uncommon, and even deaths have been recorded after heavy indulgence.

We have carefully studied the question of the fatal effects produced by the use of these

beverages and have come to the conclusion that, even if inordinately large quantities are consumed, it would be difficult to take sufficient alcohol to produce stupor, coma or death from drinking the ordinary rice or *mandwa* beers. Most of the cases of poisoning were undoubtedly due to the use of adulterated or drugged beer. The allegation of adulteration of country beer has been made in most of the provinces and, although in the case of distilled liquors and *tari*, evidence has been wanting, it has certainly been obtained with regard to country beers. In quite a number of the fatal cases, *dhatura*, *nuxvomica* or *aconite* have been detected in sufficient quantities to produce death by over-indulgence. Some of these poisonous substances have actually been detected in the fermenting cakes known as 'bakhar'. These drugs are surreptitiously added with the idea of giving the beverages a bitter taste and also with the object of increasing their intoxicating effects. From the data we have collected it is clear that habitués may be grouped into two classes with regard to the effects produced.

In the first group are included the tribes inhabiting Assam Hill Tracts right down to Burma, who use beer as an article of dietary or as a bland and mildly-stimulating drink. The Nagas, as we have stated, drink beer in lieu of water, and they are noted for their fine physique, in spite of drinking large quantities. We have not been able to detect any mental and physical deterioration in those who take such beer habitually.

To the second group belong those who use beer primarily for the intoxicating effects produced by the alcohol contained in them. To this category belong most of the races living in the plains and low-lying hill area which have a high rainfall.

Both classes undoubtedly contain a certain number of psycho-neurotic individuals who are unable to bear the strain and stress of life and resort to these drinks, but the number of persons among the tribes who use beer is very small indeed.

The witnesses who appeared before the *Indian Excise Committee* (Thomson *et al.*, 1907) expressed the opinion that even excessive use of these beers is less harmful than that of strong spirituous drinks, so long as the liquor drunk is not adulterated with deleterious substances. Bedford carefully studied the question of the alcoholic content and by-products contained in these beers. In point of by-products he found that they undoubtedly contain a high percentage of acidity and a much higher proportion of fusel oil. The quantities of fufurool present, however, was less than in country spirits. Beer drinkers, therefore, consumed comparatively small quantities of alcohol but very much larger quantities of the by-products. The general consensus of opinion was, and this is borne out by our own observations during recent years, that fermented liquors are very much less harmful

in their effects than spirits containing a high percentage of ethyl alcohol.

A large amount of experimental work was carried out by Bedford (1906) and by Chopra (1927) on both animals and men, regarding the toxic effects of alcohol and the various by-products of fermentation. The conclusions arrived at by these observers are in accord. These are:—(a) That alcohol alone is at least as injurious as alcohol *plus* by-products; (b) that while the by-products are undoubtedly noxious and the amount far exceeds that found in potable liquors, in the relatively small quantities found even in the worst samples of the liquors analysed, their action would appear to be unimportant and negligible, and (c) that spirit-drinking is more noxious than the drinking of fermented liquors, because the amount of alcohol necessary to produce toxic effects is more quickly reached and more easily exceeded. Alcohol and not the by-products is chiefly responsible for the toxic effects produced by potable spirits. Any evil effects observed were attributable more to the excessive quantity of alcohol consumed than to any action of the by-products.

From the experimental data we have obtained and from our observations in different areas, we are in a position to state that these fermented liquors do not produce any special harm, when the concentration of alcohol is low and the consumption is not excessive. The age-long experience of the hill tribes in India points to the fact that fermented beers are on the whole less harmful than distilled spirits. The by-products are not harmful in the concentrations in which they are present in these liquors, unless very large quantities are taken for prolonged periods. During the course of our inquiry we have not found any greater preponderance of cirrhosis of the liver or any of the other conditions usually attributed to the excessive use of alcohol among these races, than are ordinarily found in races who do not use these liquors.

An altogether different factor, responsible for ill health in the consumers, is the insanitary conditions under which the beer is produced; the utensils used are not properly cleaned and impure water is often used in their preparation. To these facts might be attributed the occurrence of diseases such as dysentery, diarrhoea, cholera, tuberculosis, typhoid, etc. Finally it must be mentioned that beer after storage may taste stale and sour on account of bacterial contamination, when by-products, such as acetic acid and lactic acid, are formed in abundance. The harmful effects of these drinks, therefore, appear to be due to the unsatisfactory methods of preparation and storage rather than to the actual effect of alcohol contained in them.

(C) *Effects of stronger alcoholic beverages such as country spirit and other liquors.*—There is considerable difference of opinion with regard to the ultimate effects of alcoholic drinks on the human system. These differences are probably due more to the quantity and character of the particular liquor used rather than to error of observation or analysis. The wide range of environmental conditions and the personality types is clearly responsible for some of these variations. According to some authorities, who have observed alcohol addicts amongst the native population in India, the abuse of alcohol produces permanent ill effects and disease during periods varying according to the physical powers of the individual. The most common

symptoms described are dyspepsia and emaciation in the case of country spirit, but fattening in case of beer, accompanied by diarrhoea, gastritis, cough, vertigo, cirrhosis of liver, neuritis, loss of mental power, tremors and some believe even epileptic type of fits. The chief alimentary disorders among those indulging in excessive quantities of alcohol are dyspepsia, gastritis and impairment of hepatic function. Congestion of liver and even fatty degeneration are not uncommon. No relation between chronic alcoholism and atrophic cirrhosis of the liver could be traced in our series of cases. We carefully examined the histories of all cases of atrophic cirrhosis and ascites in two of the largest hospitals in the Punjab. Only in very rare instances could any definite alcoholic history be traced. The cardio-vascular and respiratory systems are not markedly affected in chronic alcoholics in this country. In a series of 200 cases examined no marked changes were detected; the central nervous system undoubtedly bears the brunt.

Chronic alcoholics can be recognized in a number of ways. Many exhibit an unsteady gait and hasty behaviour, sometimes with an exaggerated degree of politeness. Excessive *tari* drinkers neglect their clothes, and their eyes are usually congested; the eyelids are swollen and oedematous in the same way as in nephritis. Some addicts described a wonderful feeling of exaltation and physical strength. If the abuse is persisted in it leads to indigestion, wasting of the body, cough, depression, melancholia, impotence and finally dropsy. The individual is reduced to beggary and serfdom and becomes an outcast from society, and not infrequently his career terminates in insanity.

### *Mental disorders and alcohol*

A statistical survey of such conditions has been made in the mental hospitals at Ranchi, Lahore, Madras, Nagpur and Yeravda. These observations were made by the authors in collaboration with the superintendents of these institutions, and the authors are grateful to these officers for the valuable help and suggestions given them in this work. The observations we have made show that abuse of alcohol is a causal factor in the development of insanity in many cases. There were altogether 875 cases labelled as toxic insanity in these hospitals, who gave history of alcoholism before their admission into the hospital.

1. *Minor mental disorders.*—Our observations in this connection were also made on habitual consumers who were not inmates of mental hospitals but were persons at large in the towns and villages. Most of them were doing their daily work and were earning their livelihood; a few even held positions of responsibility and trust. Minor changes in mental faculties may take place even from moderate habitual use of alcohol. The following are the common changes that have been observed:—

(a) *Minor impairment of mental faculties and judgment.*—In a series of 250 alcoholics examined, 20 per cent showed these symptoms. The degree of mental enfeeblement was sometimes so small that it was difficult to detect, but information could only be obtained through friends and relatives who could compare the past of the individual with his present condition and who could observe definite deterioration.

(b) *Progressive loss of memory.*—This was observed in individuals after 40 years of age, and in 15 per cent of this series such changes were discernible. These were associated with other senile degenerative changes such as arteriosclerosis, premature greyness, and diminution of sexual desire, etc.

(c) *Hallucinations and delusions.*—These were observed in 2 per cent of cases and were generally delusions of persecution. Auditory hallucinations were more common, and if care is not taken this may lead to paranoia.

(d) *Sexual depravity.*—This was met with in 4 per cent of the cases, most of the individuals being below the age of 30 who were given to life of debauchery. A gradually increasing suspiciousness and paranoid attitude develops with a pronounced increase in sexual excitement.

II. *Transient mania.*—The most common form seen in Indian asylums is an acute mania of short duration which was found in 10 per cent of cases labelled toxic insanity produced by alcohol. The onset is sudden and invariably follows a drinking bout; it is more common amongst persons who have a particular susceptibility to alcohol. There are instances on record where half a pint of country liquor rendered a person aggressive and violent with homicidal tendency. These persons sometime showed signs of exaltation and a sense of well-being in the beginning, followed by restlessness, noisiness and disorderly conduct. There was a tendency to commit wilful damage, often followed by complete forgetfulness of the entire incident.

III. *Hallucinations.*—These were observed in 3 per cent of the cases of toxic alcoholic insanity. Hallucinations and delusions were of frequent occurrence, when alcohol was abused for prolonged periods. This condition could be distinguished from delirium tremens by the fact that it was mostly of a coherent type, and particular hallucinations followed particular delusions. The delusions seen were mostly of suspicion and persecution and often led to acts of violence.

IV. *Delirium tremens.*—This syndrome has been rarely observed in Indian alcoholics, although it is perhaps the most common of all the mental disorders attributed to abuse of alcohol in the West. The distinguishing features are presence of delirium and tremors which are rarely present together in any other disease. It is believed by some authorities that the syndrome is a withdrawal symptom of the drug during an acute illness. This belief is supported by the fact that rapid improvement often follows the administration of alcohol during early stages of the disease. Others believe that it is toxic in nature, as excessive indulgence in alcohol produces an antitoxin which enables tolerance to be established and that delirium is caused by an excess of this antitoxin. It has also been

claimed that the serum of confirmed alcoholic addicts yields a toxin which is capable of producing delirium in dogs. The reason why delirium tremens rarely occurs among Indians is that it is only in very rare instances that such large quantities of alcohol as are imbibed by habitués in the West are taken by Indian habitués.

V. *Paranoic conditions*.—Four per cent of cases with history of alcoholism in the mental hospitals were labelled as paranoia (not true paranoia). The disorder starts with delusions of suspicion, and rapidly reaches a paranoic state. Hallucinations of hearing are frequent, and delusions generally referring to persecution by enemies. Such patients are often homicidal, and are very difficult to control. The duration of disease is usually shorter than in true paranoia. Dementia often follows and may change the picture to a considerable extent. Sometimes, when cases are mild and the drug is withdrawn early, the individual may become a useful member of society but he should be carefully guarded all the time. Most of these persons were below the age of 30 and were given to a life of debauchery and prostitution. A gradually increasing suspiciousness and paranoid attitude develop with a pronounced increase in sexual excitement.

VI. *Korsakoff's syndrome or polyneuritic psychosis*.—This is a toxic disorder which may also be due to other toxic factors such as diabetes mellitus, septic poisoning or chronic poisoning with metallic substances, such as arsenic, lead and mercury. Long-standing alcoholic intemperance is the most common cause of this disorder. The usual symptoms of the disorder are peripheral neuritis associated with the loss of memory for recent events. There may be extreme dissociation of thoughts and ideas. Alcohol probably influences both the cortical nerve cells and the peripheral nerve fibres, therefore the symptoms vary according to the region first affected. Not only memory but the self-critical faculty and sometimes the general intelligence suffers.

#### *Alcohol in relation to crime*

The relation between alcohol and incidence of crime was also studied by the present authors. In the central districts of the Punjab, for example, in Amritsar, Lahore, Gurdaspur, Ludhiana and Ferozepore, which are inhabited by Sikhs who consume alcohol in larger amount compared with other parts of the province, the incidence of crime is decidedly higher than in the rest of the province. Similarly, the incidence of crime rose in certain districts of the United Provinces and Madras and Bombay Presidencies, when the consumption of alcohol went up. Of all kinds of alcohol used in this country, it was found that country spirits were more instrumental in leading to a criminal mentality than any other kind of alcoholic liquors. Next in

order come *pachwai*, foreign liquors and *tari*. We tried to trace a history of alcoholism among 150 addicts tried for murder in these areas, and found that country spirit was the contributory cause in 12.5 per cent.

As regards the relationship between alcohol and crimes of a sexual nature, it was found that, in 120 cases charged with rape and other sexual offences, there were 50 persons who frequently indulged excessively in alcohol. Criminals sometimes take to alcohol to overcome the sense of inhibition and the association of alcoholism with prostitution is often for the same purpose.

We have already referred elsewhere in this paper to the relation between mental disease and alcoholism. Insanity might lead to drunkenness, and *vice versa*. The typical crime committed in *mania a potu* is one of violence, and the terrifying hallucinations of delirium tremens might be responsible for murder, suicide, violent assault, or damage to property. In the more chronic forms of insanity, theft, fraud, and sexual offences were not uncommon. Crimes of violence might be due to hallucinations or to delusions. Sexual offence, thefts, embezzlement, or vagrancy might be caused by mental deterioration favoured by the abnormal mental condition produced by drunkenness apart from insanity. The impairment of reason, the lack of appreciation of the consequences, the emotional disturbance, the divorce from reality, the loss of inhibition, and the consequent unleashing of personal predilections were responsible for many crimes committed by alcoholics.

There was a tendency in some alcoholics to repeat their previous crime, thus resemblance might be accentuated if there were no subsequent recollection of the crime; and if an epileptic had taken alcohol before committing a crime, the diagnosis between alcoholic and epileptic automatism might be impossible. It is also important that after certain illnesses, such as head injury, brain disease, or a previous attack of mental disease (especially delirium tremens), the offender might be more susceptible to alcohol than formerly—the so-called pathological drunkenness.

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## Medical News

### PROFESSOR SIR RAM NATH CHOPRA AND GROWTH OF PHARMACOLOGY IN INDIA

ON 16th November, 1941, Professor Sir R. N. Chopra decided to retire from Government service and with this the long association, with Calcutta, and with Calcutta's premier medical research institution (School of Tropical Medicine), of a great pioneer figure in Indian experimental medicine came to a close. Besides being distinguished for his many notable contributions in his chosen fields, Professor Chopra will be long remembered as the 'Father of Indian Pharmacology' and a founder of a school of pharmacologists. Those with whom he came into intimate contact will never forget his magnetic yet simple personality, his high idealism, his unbounded enthusiasm and devotion for work, and, above all, his remarkable capacity to promote collaborative effort amongst various groups of scientists in extending the bounds of medical knowledge.

Chopra's academic background fitted him admirably for a career in the field of medical research. As a promising scholar of the Punjab University, Chopra so ably impressed his professors that his father was advised to send him after graduation to England for higher studies. Early in 1902, Chopra proceeded to England and enrolled himself in Downing College, Cambridge. Here he stayed for six years obtaining his Science Tripos in 1905, L.R.C.P., M.R.C.S. (Eng.) in 1907 and M.B., B.Ch. (Cantab.) in 1908. British medicine and physiology was at the zenith of reputation at this period under such internationally renowned exponents as Barcroft, Langley, Gaskell, Nuttall, Dixon, Horder, Clifford Albutt, Osler, Langdon-Brown, etc., and he had the good fortune of coming under the inspiring influence of some of these teachers. Deciding to take up medical research as his life's career, Chopra entered the laboratories of Professor Dixon and took up specialized study in that field of advanced physiology which deals with the action of chemical agents on biological tissues (pharmacology). Under the direction of the late Professor Dixon, he prepared a thesis entitled 'Action of drugs on ciliary movement in the respiratory tract', which later won him the degree of Doctor of Medicine in 1912. Knowing however that he will have to earn a living, and realizing the lack of full-time opportunities in scientific medicine in India nearly 35 years ago, Chopra entered the St. Bartholomew's Hospital while still enrolled at Cambridge, and towards the latter part of 1908, competed for the I.M.S. examination standing third in order of merit. As a young I.M.S. officer he saw active service first in East Africa and later in the Afghan War, for nearly 12 years. For a man of Chopra's temperament and keenness for research and academic work, it must have been a great relief when the School of Tropical Medicine was established through the untiring efforts of Sir Leonard Rogers and he was chosen to occupy the chair of pharmacology at this institution in 1921. After a roving life of well nigh 12 years, during which the only outlet for his genius was stereotyped medical and surgical practice in the army, luck and chance placed him in his real element and once he got his mooring, he stuck to it with his characteristic zeal and tenacity until his retirement 20 years later.

In 1921, pharmacology as a science was unknown in India. Excepting the sporadic efforts made by a group of workers to study the value of indigenous anthelmintic remedies under the guidance of Father F. J. Caius of Bombay, no systematic study on the basis of animal experimentation was being undertaken in any of the university laboratories or medical institutions. Pharmacology was not included as a subject for study in the medical curriculum of Indian Universities. It was therefore no easy task for

Colonel Chopra to organize and equip a laboratory for modern experimental pharmacological work for the first time in India. As he used to admit freely to his students in later years, the task of arranging all details at the very outset of experimental work, where none had been performed before and where no practical guidance of any kind was available, offered difficulties which could not have been successfully surmounted but for the ready help of late Colonel H. W. Acton, C.I.E., I.M.S., then professor of pathology and bacteriology at the School of Tropical Medicine, and the advice and guidance from Cambridge of his professor, late Professor W. E. Dixon, F.R.S. His first paper on 'Therapeutics of Emetine' was published in 1922 in collaboration with Professor B. N. Ghosh (now professor of pharmacology at the Carmichael Medical College), more than a year later from the time he started work at the School, and this probably was the first paper published in India where the toxic effects of repeated doses of emetine injections on the cardiac musculature were demonstrated on experimental animals, and which, incidentally, served as the first note of warning in India against the dangerous practice of employing heroic doses of emetine in the treatment of all types of dysenteries and liver complications. Since then, a steady stream of researches on various aspects of tropical medicine, experimental pharmacology and therapeutics, drug addiction, indigenous drugs, drug standardization, clinical medicine, etc., emanated from Chopra's laboratory and Chopra spared no pains, whenever opportunity presented itself, in training up a band of young workers to carry on his field of studies.

Chopra's contributions to medical science cover a wide range of subjects. Space will not permit any detailed analysis or evaluation of his work. The main theme which seems to have attracted his attention early and to which he returned again and again was the study of Indian indigenous drugs—their chemical composition, the physiological action of their active principles on living tissues *in vivo* and *in vitro*, and the biochemical and bio-physical changes brought about in mammalian organisms on the administration of these active principles. The aim and scope of the work, as he conceived it as early as 1922, was as follows:—

- (1) To make India self-supporting by enabling her to utilize the drugs produced in the country, by manufacturing them in a form suitable for administration.
- (2) To discover remedies from the claims of Ayurvedic, Tibbi and other indigenous sources suitable to be employed by the exponents of western medicine.
- (3) To discover the means of effecting economy, so that these remedies might fall within the means of the great masses in India whose economic condition is very low.
- (4) And eventually, to prepare an Indian Pharmacopoeia.

Such a comprehensive and ambitious approach to a complicated problem could not naturally be managed single-handed and Chopra realized from the very beginning, as Sir Leonard Rogers did, that collaboration with botany and chemistry was essential in tackling such problems. Here started a partnership between him and Professor S. Ghosh, professor of chemistry at the School of Tropical Medicine, which was destined to last all through his career at the School and which, like the partnership between Sir Henry Dale, F.R.S., N.L., and Late Professor G. Barger, F.R.S. of London, yielded very fruitful and far-reaching results in the field of Indian indigenous drugs. Practically all the indigenous drugs that are now being used by the medical profession in India in place of imported drugs may be said to be the outcome of the researches emanating from the Chopra-Ghosh school of workers. From scientific and academic viewpoints, the work on indigenous drugs has set up a high standard of medical and chemical research in India and has focused international attention to it. Its value from the economic viewpoint is no less

worthy of note, as it has given a definite fillip to the Indian drug industry. Chopra's book on 'Indigenous Drugs of India' and 'Medicinal and Poisonous Plants of India' (2 vols.) will stand as lasting monuments of his enthusiasm and endeavour in a field which has seldom been trodden by scientific medical workers.

There was, however, another side of Chopra's interest in pharmacology which manifested itself in a large number of his published papers and in his books on 'Tropical Therapeutics' and 'Anthelmintics'. He was one of those, like the late Professor A. J. Clark of Edinburgh, who wanted to bridge the gap between pharmacology, therapeutics, and clinical medicine. He belonged to that group of scientists who were trained to study and appreciate the whole field of experimental medical science, particularly its 'applied' side as distinguished from 'fundamental and basic' concepts. Most of his work therefore leaned heavily towards studying problems of 'practical' utility to professional medical practice in the tropics. This is the reason why he moved his interest frequently from investigations pertaining to the field of tropical medicine such as asthma, lathyrism, epidemic dropsy, amebic dysentery, helminthiasis, malaria, etc., to problems of drug standardization and adulteration, the scientific study of the effects of habit-forming drugs, e.g., opium, cannabis, alcohol, chloral hydrate, cocaine, etc., on laboratory animals and human beings, the effects of chemotherapeutic remedies on mammalian system, the devising of laboratory tests for the diagnosis of kala-azar in outdoor clinics and in the field, etc., etc. In the apparent 'diversity' of topics dealt with by Chopra and in the very wide range of his scientific contributions, there is evident to critical observers a 'latent central theme' and that is, his effort to always interweave and interdigitate the work of the laboratory and the hospital. Though essentially a laboratory man with a preferential liking for experimental therapeutics, Chopra's later experience at St. Bart's Hospital, at the Carmichael Hospital for Tropical Diseases, and in the Army Medical Service rounded off his university training in pharmacology and served to extend his knowledge and interest to the science of disease as a whole, and he became ultimately a combined product of the laboratory and the clinic. Judged from this angle, Chopra's contributions are undoubtedly very significant and give clear evidence of the range and versatility of his mind.

The pioneer work of Chopra in building up Indian pharmacology, and in giving an impetus to medical and scientific research on 'applied' problems of peculiar interest to India, soon marked him out as an outstanding Indian in the field of medical research. One instance of his consuming desire to put India in the map of international medical and scientific research is provided by the fact that he never yielded to the attraction, so commonly seen in many foreign-trained scientists, of publishing his research papers in foreign journals. The writer recalls one instance when one of his British friends asked him to publish the results of one of his investigations in the *British Medical Journal*. Chopra politely wrote back saying that the *Indian Medical Gazette* would serve the purpose all right and he would send reprints to all the persons in England interested in that question. Chopra was fortunate in having an enterprising spirit coupled with admirable patience and grit, which made him an ideal administrator, a stimulating teacher and a sympathetic office-master. He exercised a great influence on many pupils, assistants and others who came in contact with him during the course of his long scientific career. None of the many who at one time or another were privileged to work in his laboratory failed to profit by his intense enthusiasm for research, his youthful outlook on science, his tremendous optimism even in the face of problems which seemed incapable of solution, and above all, his courteous dealings at all times with even his laboratory attendants. Despite his great absorption in his administrative and book-writing work in later years, the door of his room was always open

to any worker in his or other laboratories of the School or to any former pupil or scientific friend. When one came for advice, one found a man who seemed to be working against time, but nevertheless, prepared to stop to listen to him attentively and give whatever advice he could to a younger assistant or colleague. In this way and by other sterling qualities of the head and heart, Chopra unconsciously served to build up a school of Indian pharmacology in the comparatively short space of 20 years from almost nothing but descriptive *materia medica* and non-scientific teaching of older days. If Chopra did not do anything else but this, his name would remain to posterity. As 'Father of Indian Pharmacology' in India, Chopra's position may be compared to those of Oswald Schmiedeberg of Germany and John Jacob Abel of America. Professor Schmiedeberg\*, who is credited with the establishment of the first properly equipped pharmacological laboratory in a University, had nearly 40 pupils who occupied important chairs in almost all countries of Europe and America. The international character of the school developed by him can be judged from the following representative pupils:—Abel (Michigan and Hopkins); Meyer (Vienna), Magnus (Utrecht), Gottlieb (Heidelberg), Heffter and Heubner (Berlin), Cloetta (Zurich), Pohl (Prag), Morishima (Japan), Maogori (Padua), Cushny (Michigan, London and Edinburgh), Baldovi and Gaglii (Rome), Mosso (Genoa), Poulsson (Christiana), Bock (Copenhagen), Santesson (Stockholm), Kobert (Dorpat), Harnack (Halle), Dresser (Elberfeld), Wallace (New York) and Stockman (Glasgow). Professor Abel is also credited with training nearly 25 pupils who are now teaching pharmacology all over America, Japan, and Korea. During the last 20 years, Chopra had succeeded in developing an all-India School of Pharmacology and had, in collaboration with Professor S. Ghosh, trained more than 45 workers in the chemistry and pharmacology of drugs including indigenous drugs. A few names would indicate the representative character of the school developed by him:—Professor B. N. Ghosh (Calcutta), Paranjpe (Bombay), Nanda (Lahore), David (Madras), Iswariah (Andhra), Dikshit (Bombay), P. De (Calcutta), Venkatachallam (Madras), Grewal (Lahore), Chakravarty (Agra), Das (Nagpur), Mukerji (Calcutta), Sharma (Amritsar), Gupta (Calcutta), I. C. Chopra (Kashmir), B. C. Bose (Calcutta), Ratnagiriswaran (Madras), Chowhan (Meerut), N. K. Bose (Delhi), Chatterjee (Calcutta), G. S. Chopra (Karachi), Miss Chaudhuri and Miss Vethavanum (Delhi), Dutt (Calcutta), Kahili (Rangoon), Muthanna (Karachi), A. Chatterjee (Darjeeling), N. De (Bangalore), etc.

Honours, both in appreciation of his contributions to medical science, and for all his activities in connection with medical and public health organizations and in connection with the initiation and development of the drug control organization in India, came to him from all quarters—from his *alma mater* (Cambridge University), from the University of Calcutta and other scientific bodies in India, Great Britain, Europe and America, and from the Government under which he served for a long period. When he retired last November to take up the duties of the Director of Medical Services and Drug Research in Jammu and Kashmir State, his hair was seen to be grey but his head remained as before—still sympathetic and approachable, still keen to work in his chosen field of Indian drugs as long as physical powers would permit, never to flag until Nature would demand it. It did not fall to his lot to make epoch-making discoveries, but his was the glory of a pioneer 'blazing the trail' in a field (study of indigenous drugs) so far untrodden and neglected in India but, nevertheless, a field pregnant with possibilities. A worker in his very core, Chopra's many pupils, friends, and acquaintances cannot help

\* Festschrift to Professor Schmiedeberg. *Archiv. f. exper. Path. u. Pharmacol.*, 1908 (Supplementary volume).

but feel the loss of his genial company and inspiring leadership, but can be reconciled to it by his long life of accomplishments and by the fact that he is still happily 'in harness' in a better climate at the Kashmir State and is actively engaged in building up another research centre in Northern India.

B. MUKERJI.

### MALE NURSES FOR MILITARY HOSPITALS

THE Government of India have decided to recruit 'male nurses' for employment in military hospitals during the present emergency. These men will be enrolled as warrant officers, class II, in the Indian Medical Department.

Men offering for this service must be registered as 'male nurses' with a provincial nurses registration council. Persons in government service, who wish to volunteer, will also be eligible.

Besides salary and allowances, men employed as 'male nurses' will be entitled to free rations and accommodation.

### THE TUBERCULOSIS ASSOCIATION OF INDIA

#### TUBERCULOSIS NEWS

#### *Hassan Masud Suhrawardy Memorial Anti-Tuberculosis Challenge Shield Competition*

ENTRIES for the Hassan Masud Suhrawardy Memorial Anti-Tuberculosis Challenge Shield Competition on the basis of work done by the respective tuberculosis organizations during the year 1941 have been invited up to the 15th July, 1942.

The competition is open to any corporation, municipal council, municipal committee or district local authority in British India or in an Indian State doing anti-tuberculosis work or to any other organization, private or aided, which is doing anti-tuberculosis work and which the central committee of the Tuberculosis Association of India may from time to time admit to be eligible for the competition.

In awarding the shield full consideration will be given to the efforts made and results achieved in the prevention of tuberculosis during the year 1941.

The winning body will be entitled to hold the silver shield for one year, and its name will be inscribed thereon.

#### *Special Tuberculosis Number of the 'Indian Medical Gazette'*

At the request of the Tuberculosis Association of India, the editor of the *Indian Medical Gazette* has agreed, as in the past, to publish a special tuberculosis number of the *Gazette* in October this year. This will be published on the lines of previous numbers issued since the year 1937.

Articles on any aspect of tuberculosis—clinical, medical or preventive—for the forthcoming number have been invited from tuberculosis workers by the middle of July.

#### *Lady Linlithgow Sanatorium, Kasauli*

The following have been appointed members of the sanatorium managing committee for one year:—

The Chairman, Tuberculosis Association of India.

The Vice-Chairman, Tuberculosis Association of India.

The Honorary Treasurer, Tuberculosis Association of India.

Mr. D. N. Mitra, C.B.E., Solicitor to the Government of India.

Mr. U. N. Sen, C.B.E., Managing Director, Associated Press of India.

Sardar Bahadur Teja Singh Malik, C.I.E., I.S.E., Chief Engineer, C. P. W. D.

Major-General J. Taylor, C.I.E., D.S.O., I.M.S., Director, Central Research Institute, Kasauli.

Mr. D. D. Anand, M.A., Executive Officer, Kasauli Cantonment.

The Medical Commissioner, Tuberculosis Association of India.

#### *Medical Commissioner, Tuberculosis Association of India*

Dr. C. Frimodt-Møller, the first Medical Commissioner of the Association, had unfortunately to resign his appointment owing to failing health at the end of March 1942.

Dr. Frimodt-Møller was on medical leave since the 11th of August, 1941, and Dr. P. V. Benjamin, Medical Superintendent of the Union Mission Tuberculosis Sanatorium, officiated for him for about five months from the end of October last.

The affiliated provincial and state tuberculosis associations have been asked to recommend names of suitable candidates for the post. The candidates are expected not only to have the necessary academic qualifications in the special subject but should also have had wide experience in both the administrative and clinical fields.

#### *New Tuberculosis Institutions*

Her Excellency the Marchioness of Linlithgow laid the foundation stone of the Lady Linlithgow Tuberculosis Hospital, Patiala, on the 3rd March, 1942.

### ROSE HIPS FOR ORANGES

TWO HUNDRED tons of rose hips gathered from the hedges of England and Scotland last autumn have been turned into syrup for the older children in Britain who cannot get a regular supply of oranges.

Like the orange, rose hips are a rich source of vitamin C, the anti-scurvy vitamin.

Before the war it never occurred to anybody to use rose hips, but when the supply of oranges dwindled a small army of Boy Scouts, Girl Guides, teachers and Women's Institute members turned out into the lanes with their baskets.

Even housewives who were expert jam makers found it difficult to keep the hip hairs out of the syrup and the hips were therefore sent off to nine factories which have now produced from them 600,000 bottles of syrup. Young children are sipping it with relish at the rate of one teaspoonful a day. Two teaspoonsful in the twenty-four hours give all the vitamin C which older boys and girls require.

Britain's Ministry of Health are so pleased with the result that they are hoping for a much bigger collection of rose hips when autumn comes round again.

### RHEUMATISM IN CHILDHOOD AND ADOLESCENCE\*

WE are pleased to receive a copy of this reprint. It is an outcome of an endowment founded to commemorate the memory of Dr. Elizabeth Mathai—such endowments for furtherance of medical science are relatively few in Indian Universities. The subject is well chosen, in view of the condition that the lectures should be definitely connected with some aspect of diseases of children and women. This series of three lectures, apart from confirming the established fact about the prevalence of rheumatism in this country, presents the available local material admirably, and insists on the importance of early detection of cases and their organized supervision.

\* Rheumatism in Childhood and Adolescence. By P. Kutumbiah, B.A., M.D., M.R.C.P. (Lond.). (Reprinted from *Indian Journal of Pediatrics*, Vol. VIII, Nos. 30 and 32, 1941.)

## Public Health Section

### THE HEALTH STATUS OF A BENGAL VILLAGE: ALL-INDIA INSTITUTE OF HYGIENE AND PUBLIC HEALTH STUDENTS' SURVEY\*

For the past three years the D.P.H. students of the All-India Institute of Hygiene and Public Health, Calcutta, have been carrying out a survey of the health conditions of a rural Bengali community, including such data of socio-economic significance as can be included within the limitations of a period of five days. The survey has a twofold purpose: (a) to train the students in survey methodology including collection, analysis and interpretation of data, and (b) to give opportunity for the students to secure some first-hand acquaintanceship with rural conditions. A survey was made of Ratanpur in February 1942 and the essential data collected by the students are summarized below :—

#### *Physiography*

The village Ratanpur is 22 miles from Calcutta and is situated to the north-east of Singur in the Hooghly district. The village itself has developed in a ribbon fashion along the foot-path connecting Singur to Chandernagar and extends over nearly a mile and a quarter. There is no planning either in house-building or in village extension. The river Damodar situated about 14 miles to the west of the village and the river Hooghly situated about 9 miles to the east, run from North to South. The natural drainage of the tract has been interfered with or impeded by the following factors:—

(1) The silting up of the connecting channels, viz, the Kananadi, Kana Damodar between the Damodar and the Hooghly and of the river Saraswati.

(2) The construction of the left embankment of the Damodar and other embankments in connection with the railways and roads.

With the decay of the river system there was an urge for the construction of the Eden Canal for supplying people with drinking water. This canal with its distributary system was modified later for the purpose of irrigation as well. One of such distributaries connecting the Kananadi with the Saraswati, runs through the Ratanpur village. But it has failed to serve both the purposes mentioned above.

#### *Climatology*

The climate of the place is similar to the major part of the Western Bengal. The year

can be divided into three distinct seasons—winter, summer, and the rainy season. Winter lasting from November to February is pleasant with little rainfall. During the summer months from March to June the temperature varies from 80°F. to 105°F. but the humidity does not fall below 60 per cent. The average annual rainfall is 59 inches, much of it occurring between July and October when the humidity is as high as 90 per cent.

#### *Water supply*

Water supply can be grouped into two headings: (1) for irrigation, facilitated to some extent by the Eden Canal; (2) for domestic purposes. Water from the *dobas* and from the dying tributaries is also utilized for irrigation.

For domestic purposes water is obtained mainly from two sources. The four tube-wells in the village, of which one requires immediate repair, supply water for drinking purposes while the numerous *dobas* are used for ablution, bathing, washing and also for cattle. Approximately each tube-well serves a population of 250, which is adequate under normal conditions; but in view of the ribbon development of the village, people have to go a long way for obtaining drinking water. Two new tube-wells were constructed by the students themselves during their survey and fitted with pumps and impermeable aprons and platforms and should alleviate to some extent the difficulty in getting good drinking water supply. The water in the Eden Canal is also used by those living near it, as others use *doba* water.

There are three dug-wells in the village of which one is *pucca*. Water from these is used both for drinking and other domestic purposes. No bacteriological examination was done to determine the quality of water from the tube-wells and the dug-wells.

#### *Disposal of excreta*

There are two houses with latrines of which one has a hand flushing closet with a septic tank. These are only used regularly by the female members of the house. There are no public latrines except for the two bore-hole latrines constructed by the D.P.H. students. The animal excreta, valuable as manure, are usually dumped in a corner near the house and converted into cakes for use as fuel.

#### *Disposal of refuse and garbage*

The refuse and garbage from the houses and cattle-yards are collected and heaped in manure-pits behind the houses. These pits are fairly distant from living quarters so as not to cause any nuisance to the inmates. Though there is no public agency responsible for the disposal of

\* Arranged by Dr. C. Chandra Sekar and Dr. B. Mukerjee, of the Section of Epidemiology and Vital Statistics.

refuse, one is struck by the general cleanliness of individual houses.

### *Housing conditions*

Fifty-seven houses were surveyed for their conditions regarding (1) openness, (2) approach, (3) materials, (4) cleanliness, (5) dampness, (6) over-crowding, (7) ventilation and lighting, (8) kitchen and food, (9) bathing and washing facilities, (10) refuse collection and disposal, (11) latrine accommodation, (12) water supply and (13) other defects including nuisance from live-stock, flies, etc. The standards used for appraising the various items were purposely made lenient on account of rural conditions and even then only one house out of 57 could be classed as 'satisfactory' in every respect. However, the houses were not equally defective with regard to all items. With regard to openness, approach, materials, cleanliness and over-crowding at most only 25 per cent houses were below standard.

Most of the houses have open spaces, and are detached or semi-detached with fairly good approaches. The walls are massive and are either built wholly of mud or of mud over bamboo frame-work. The roofs are thatched. Few houses are white-washed. The floor is also of mud, well raised above the surrounding ground yet about 25 per cent of the houses are reported to be damp during the rains. Although most of the houses are provided with sufficient windows for ventilation, the lighting is poor due to the absence of white-washing of the walls. The kitchens are generally separate from the living rooms. Invariably the kitchens are well-kept and food is kept covered. Bathing and washing

breeding is prolific especially in wet weather. Mosquitoes are found in plenty especially in cowsheds and many villagers use mosquito-curtains.

### *Vital statistics*

The population of the village at the time of survey was 1,071, the population 6 months before the survey as estimated by the natural increase method and used for the calculation of rates being 1,054. The population density works out to 5.4 persons per acre, reckoned on the area of Ratanpur, excluding only the paddy fields.

The age and sex distribution of the village compared to that of Bengal according to the 1931 census is given in Table I.

The crude birth rate for the year preceding the survey was 49.5 *per mille* and resident birth rate 48.5 *per mille*. The birth rate is much higher than that of Bengal which according to the D.P.H.'s report for 1939 is 32.0 and which even after allowing for incomplete registration of births cannot be much more than 42.0 *per mille*. Considering the fact that women in the reproductive age group at Ratanpur are lower than those in Bengal, the higher birth rate reflects on the higher fertility rate of the women in this village. It is not, therefore, surprising that the general fertility rate for women of 12 to 50 years of age works out to 209 *per mille*.

The crude death rate of the village is 18.03 *per mille* and the resident death rate 17.07 *per mille*. It should be observed that in spite of a larger proportion of individuals below 10 years of age and over 40 as compared to Bengal, the crude death rate of the village should be actually

TABLE I

| Age group<br>in years | RATANPUR |         |                     |         | BENGAL          |         |                     |         |
|-----------------------|----------|---------|---------------------|---------|-----------------|---------|---------------------|---------|
|                       | Number   |         | Percentage of total |         | Number in '000s |         | Percentage of total |         |
|                       | Males    | Females | Males               | Females | Males           | Females | Males               | Females |
| 0-1 ..                | 27       | 21      | 2.52                | 1.96    | 847             | 851     | 1.66                | 1.67    |
| 1-5 ..                | 76       | 56      | 7.10                | 5.23    | 3,077           | 3,168   | 6.03                | 6.20    |
| 5-10 ..               | 84       | 96      | 7.84                | 8.96    | 3,633           | 3,227   | 7.11                | 6.32    |
| 10-15 ..              | 70       | 51      | 6.54                | 4.76    | 3,178           | 2,840   | 6.22                | 5.56    |
| 15-20 ..              | 48       | 46      | 4.48                | 4.30    | 2,325           | 2,592   | 4.55                | 5.07    |
| 20-40 ..              | 143      | 147     | 13.35               | 13.73   | 8,799           | 7,989   | 17.22               | 15.64   |
| 40-60 ..              | 77       | 67      | 7.19                | 6.26    | 3,813           | 3,056   | 7.46                | 5.98    |
| 60 and over           | 29       | 33      | 2.70                | 3.08    | 885             | 806     | 1.73                | 1.58    |
| TOTAL ..              | 554      | 517     | 51.72               | 48.28   | 26,557          | 24,529  | 51.98               | 48.02   |

facilities are almost non-existent inside houses. The same applies to drinking water supply. Most of the houses have cattlesheds on the premises which are kept fairly clean. Pigs and poultry are not found in the houses. Though manure-pits are not close to the houses, fly

lower—the crude death rate of Bengal in 1939 being 21.9 *per mille*.

The low death rate and high birth rate lead to a high value for the vital index which is 284 for the village compared with 147 for Bengal in 1939.

The infant and neonatal mortality rates of the village as compared to Bengal are as follows:—

|                  | Ratanpur         | Bengal (1939)    |
|------------------|------------------|------------------|
|                  | <i>per mille</i> | <i>per mille</i> |
| Infant .. .. .   | 78.4             | 146.6            |
| Neonatal .. .. . | 39.2             | 86.3             |

The above rates for the village are based on small numbers and as such *much reliance cannot be placed on them for comparative purposes*. Yet the low figures for infant mortality do arrest attention, especially as only 4.2 per cent deliveries receive the attention of certified midwives whereas 85.0 per cent are conducted almost completely by the conventional *dais* and the rest are supervised by relatives and friends.

Judging from the pregnancy history of the women in the village, the still birth rate is 38.3 per 1,000 live and still-births (39.8 per 1,000 live-births), the rate for Bengal in 1939 being 41 per 1,000 live-births. Abortion rate is 7.5 per 1,000 pregnancies.

The specific mortality rates by age groups are as follows:—

| Age groups      | Rate<br><i>per mille</i> | Age groups     | Rate<br><i>per mille</i> |
|-----------------|--------------------------|----------------|--------------------------|
| Below 1 year .. | 78.4*                    | 20-40 years .. | 14.0                     |
| 1-5 years ..    | 30.3                     | 40-60 " ..     | 14.1                     |
| 5-10 " ..       | 16.9                     | 60 and over .. | 32.8                     |

\* Infant mortality rate.

The specific mortality rates by causes are:—

| Causes                      | Rate per<br>100,000 | Causes        | Rate per<br>100,000 |
|-----------------------------|---------------------|---------------|---------------------|
| Typhoid ..                  | 284.6               | Chickenpox .. | 94.9                |
| Dysentery and<br>diarrhoea. | 284.6               | Pneumonia ..  | 94.9                |
| Tuberculosis ..             | 189.8               | Diphtheria .. | 189.8*              |
|                             |                     | Others ..     | 664.1               |

\* 1,111.1 per 100,000 for children under 5.

There were no deaths due to cholera or smallpox during the year under discussion. Diarrhoea and dysentery and enteric group of diseases are the commonest causes of death. These and malaria are also common causes of sickness as brought out by the following table giving morbidity rates:—

Morbidity rates per 100,000 population:—

| Causes                        | All ages | Children<br>under 5 |
|-------------------------------|----------|---------------------|
| Cholera .. .. .               | 189.8    | ..                  |
| Typhoid .. .. .               | 1,518.0  | ..                  |
| Pneumonia .. .. .             | 284.6    | ..                  |
| Smallpox .. .. .              | 284.6    | ..                  |
| Chickenpox .. .. .            | 94.9     | ..                  |
| Dysentery and diarrhoea ..    | 1,043.6  | ..                  |
| Tuberculosis .. .. .          | 284.6    | ..                  |
| Other respiratory diseases .. | 94.9     | ..                  |
| Malaria .. .. .               | 2,941.2  | ..                  |
| Ankylostomiasis .. .. .       | 189.8    | ..                  |
| Diphtheria .. .. .            | 284.6    | 1,666.7             |
| Whooping cough .. .. .        | 94.9     | 555.6               |
| Measles .. .. .               | 284.6    | 1,666.7             |
| Others .. .. .                | 4,838.7  | ..                  |

The intestinal diseases are responsible for about 23.7 per cent of the morbidity figures. This high incidence is no doubt to be attributed to the unrestricted pollution of water sources especially *dobas* and to the absence of fly-control measures. The gravity of this problem is further brought out by the results of stool examination for hookworm ova by salt-floatation method in which out of 400 samples 233 were positive. The hookworm infestation was manifested equally by both sexes.

Though there were two cases of cholera and three of smallpox there were no deaths from these causes.

### Health of the community

A general health examination was made and the individuals classified into four categories: (1) well, (2) acutely ill, (3) chronically ill, and (4) indifferent health. All persons whose state of health permitted them to carry on their normal duties efficiently were classified as 'well' while those who complained of vague ill-defined ailments which though not holding them back from their work yet interfered with the proper execution of it were classed as being in 'indifferent' health. The terms 'acutely ill' and 'chronically ill' were used in the accepted sense of the terms. The result of the examination showed that 87.6 per cent individuals were well, 0.4 per cent acutely ill, 0.8 per cent chronically ill and the rest 11.2 per cent in indifferent health. Both amongst males and females 88 per cent. were well. The percentages of persons classified as well, in the different age groups, are as follows:—

| Age groups | Percentage<br>well | Age groups  | Percentage<br>well |
|------------|--------------------|-------------|--------------------|
| 0-1 ..     | 77.1               | 20-40 ..    | 91.4               |
| 1-5 ..     | 85.6               | 40-60 ..    | 84.7               |
| 5-10 ..    | 91.1               | 60 and over | 79.0               |
| 10-20 ..   | 88.8               |             |                    |

The above figures indicate that more than one-tenth of the community is either acutely ill or in



indifferent health at any given time, infants and old people being the worst sufferers.

Examination of the condition of the heart showed that in 96.5 per cent individuals the heart was normal whereas in 3.0 per cent there was functional disease and in 0.5 per cent organic disorder was present.

Examination of the lungs indicated that in 1.0 per cent individuals there was abnormality and these could be divided into three groups as follows:—

| Abnormalities of lung | Frequency |
|-----------------------|-----------|
|                       | per cent  |
| Congestion ..         | 0.4       |
| Catarrh ..            | 0.3       |
| Chronic disease ..    | 0.3       |

Examination of other organs revealed the following percentages of defects:—

| Organs    | Percentages found defective | Organs                 | Percentages found defective |
|-----------|-----------------------------|------------------------|-----------------------------|
| Eye ..    | 19.9                        | Subcutaneous tissue .. | 13.0                        |
| Nose ..   | 19.3                        | Bones ..               | 0.5                         |
| Mouth ..  | 25.9                        | Lungs ..               | 1.0                         |
| Teeth ..  | 35.1                        | Circulatory system ..  | 35.1                        |
| Throat .. | 18.6                        | Abdomen ..             | 7.7                         |
| Ear ..    | 2.2                         | General ..             | 7.5                         |
| Hair ..   | 4.8                         |                        |                             |
| Skin ..   | 28.6                        |                        |                             |

The organs in which the defects are commonest are teeth, circulatory system, skin and mouth. Defects in eye, throat and nose though less common are quite considerable.

The hæmoglobin percentage of the community as determined by Tallqvist method is below standard and almost all the circulatory defects are perhaps due to the anæmic state of the population.

| Hæmoglobin percentage | Males    | Females  |
|-----------------------|----------|----------|
|                       | per cent | per cent |
| -50                   | 2.2      | 2.6      |
| -75                   | 73.6     | 84.0     |
| -100                  | 24.2     | 13.4     |

The women are more anæmic than men. The cause of such widespread anæmia is not very clear especially in view of the fact that only 2.4 per cent of persons exhibited an enlarged spleen, while out of 897 persons examined for the presence of malarial parasite in the blood 0.1 per cent proved positive.

During the survey there were 28 pregnant women in the community. The table below

gives the number of pregnant women according to parity:—

| Parity | Number | Parity | Number |
|--------|--------|--------|--------|
| 1      | 4      | 6      | 2      |
| 2      | 5      | 7      | 2      |
| 3      | 5      | 8      | 1      |
| 4      | 4      | 9      | 1      |
| 5      | 4      | 10     | 1      |

Of the above 71.4 per cent were healthy, 7.1 per cent complained of pain, another 7.1 per cent complained of headache and the rest had minor complaints. In only 20 cases inclusive of the 4 primiparae could the risk to the mother and child be ascertained. Of these in 3 cases of multipara the risk to the mother was moderate while in one case each of the multipara was there 'moderate' and 'grave' risk to the infant. None of the pregnant women attended the clinic attached to the Health Unit at Singur. In nearly 60 per cent of the cases the women had not been visited by health visitors.

Early marriage amongst girls is common, though not the rule, as 39 per cent girls between 12 and 15 years are reported as unmarried. Since the median age at marriage of all the women in the village is about 11 years there is an indication that the age at marriage for girls is on the increase. There is usually a time lag between the age at marriage and age at cohabitation with the result that out of 269 married and widowed women in the village only 15 have had their first pregnancies before 14 years of age.

Due to lack of standards it is not possible to comment on the state of development of the infants. All the infants between 5 and 6 months were over 10 pounds in weight and one infant 9 months old was more than 20 pounds. The average heights at different months is given in the following table:—

| Age in months | Average height in inches | Age in months | Average height in inches |
|---------------|--------------------------|---------------|--------------------------|
| 0-            | 18.2                     | 5-            | 22.5                     |
| 1-            | 18.5                     | 6-            | 20.8                     |
| 2-            | 21.3                     | 8-            | 25.3                     |
| 3-            | 22.5                     | 10-           | 26.3                     |
| 4-            | 24.1                     |               |                          |

Regarding dentition it may be mentioned that no infant below 8 months had any teeth erupted and of the infants above 8 months, 6 had not developed any tooth at all while the others had on an average 5 teeth. None of the infants had been weaned though some of them received solids even after the fifth month. Fresh milk and cereals are regularly supplemented to mother's milk after the sixth month. It is the exception rather than the rule for infants to get fruit juice and none is given egg, fish or meat.

The average weight of pre-schools between 1 and 2 years of age is 20.3 pounds for males

and 18.7 for females. The same for the age-group 2-5 years is 26.5 pounds for males and 24.0 for females. The heights in inches in the different age groups are:—

| Age groups | Males | Females | Age groups | Males | Females |
|------------|-------|---------|------------|-------|---------|
| 1-2        | 29.0  | 27.2    | 2-5        | 34.8  | 33.3    |

Of the 21 pre-schools aged between 2 years 6 months and 2 years 9 months, 18 had cut 20 teeth. All the pre-schools above 2 years and 9

milk obtained is sold to supplement the family income. The food of the villagers is very deficient in animal proteins. Vegetables are usually grown in the courtyards and used by the family. The villagers eat fish, though not regularly.

The general under-development of the community directs attention to the nutrition question. A diary method of nutritional survey of 100 families for four days gave the following figures *per capita* consumption: the standards used for comparison are based on the recommendations of the Food Committee, British Medical Association and the Technical Commission of the League of Nations:—

| Essential food component | Per capita consumption per day | Per capita requirement per day | Adequate or not, if not by how much? |
|--------------------------|--------------------------------|--------------------------------|--------------------------------------|
| Animal protein .. ..     | 6.9 gm.                        | 50.0 gm.                       | 43.1 gm.                             |
| Vegetable protein .. ..  | 58.1 gm.                       | 50.0 gm.                       | Adequate                             |
| Fat .. ..                | 31.6 gm.                       | 50.0 gm.                       | 68.4 gm.                             |
| Carbohydrate .. ..       | 598.3 gm.                      | 425.0 gm.                      | Adequate                             |
| Calories .. ..           | 3,088.0 cal.                   | 3,000.0 cal.                   | Adequate                             |
| Calcium .. ..            | 0.45 gm.                       | 0.75 gm.                       | 0.30 gm.                             |
| Phosphorus .. ..         | 1.96 gm.                       | 1.00 gm.                       | Adequate                             |
| Iron .. ..               | 31.33 mgm.                     | 10.00 mgm.                     | Adequate                             |
| Vitamin A .. ..          | 924.00 µg.                     | 1,000.00 µg.                   | 76.00 µg.                            |
| Vitamin B .. ..          | 2,390.00 µg.                   | 900.00 µg.                     | Adequate                             |
| Vitamin C .. ..          | 157.00 mgm.                    | 50.00 mgm.                     | Adequate                             |

months had 20 teeth. It is surprising that 12.5 per cent children between 4 and 5 years and about 50.0 per cent children between 2 and 4 years have not been weaned. The strain on maternal health due to delayed weaning though considerable is not fully appreciated by the villagers.

The average weight and height for age groups greater than 5 years are given below separately for males and females:—

| Age groups  | WEIGHT IN POUNDS |         | HEIGHT IN INCHES |         |
|-------------|------------------|---------|------------------|---------|
|             | Males            | Females | Males            | Females |
| 5-10 ..     | 38.1             | 38.9    | 42.4             | 43.6    |
| 10-12 ..    | 57.4             | 60.0    | 50.8             | 52.0    |
| 12-15 ..    | 66.2             | 66.7    | 54.3             | 54.2    |
| 15-20 ..    | 84.8             | 82.4    | 61.3             | 57.0    |
| 20-40 ..    | 102.8            | 90.4    | 62.6             | 57.7    |
| 40-60 ..    | 109.0            | 87.2    | 63.6             | 57.9    |
| 60 and over | 90.9             | 84.6    | 62.7             | 57.0    |

The weights and heights had they been recorded for individual ages between 5 and 10 years would have provided a sensitive index to judge growth. Yet the table above shows clearly that the average weight is below par.

#### Nutritional state

Rice is the staple food of the population. Though each family has a cow, the bulk of the

The diet is deficient with regard to animal protein, fat, calcium, and to a slight extent in vitamin A. Considering the diet of the pre-school children only 5.3 per cent receive more than 10 ounces of milk per day, 8.3 per cent get fruit twice a week, 3.8 per cent get eggs twice a week and 1.5 per cent get meat twice a week. 74.3 per cent get cereals daily. No wonder that with such deficiencies in the important food elements intimately connected with growth, the community should be below par in physique.

#### Epidemiological factors

Under-nourishment may affect community health by lowering resistance to infection. Yet it is felt that even in the absence of facilities for immediate improvement of the economic condition and thus the nutrition status of the community, such communicable diseases as smallpox, typhoid and cholera can however be checked by control measures only. So a study of the epidemiological factors of the community with respect to such diseases merits attention.

The community being mostly agricultural, there is hardly any movement of the population from in and out of the village. An occasional visit to relatives may take the villager away just for a few days. Aggregation and dispersal of any magnitude takes place only on two days in a week when the villagers visit the bazar in Singur. Occasionally big *Jatras* are arranged locally which are attended by large groups of people from neighbouring villages. The population thus being practically closed, it should not

be so difficult to keep away communicable diseases.

As already stated intestinal diseases are the commonest cause of morbidity. The unclean habits of the community in the indiscriminate pollution of the surroundings, the absence of tube-wells within easy reach offering an inducement for the use of *doba* water for cooking, etc., no doubt are the major factors responsible for this. The fairly loose and always moist soil, the high temperature and humidity and the shade given by rank vegetation favour the development of the hookworm larvæ, which infest and undermine the general health of the community.

During the year under review, there have been cases of easily controllable communicable diseases as smallpox, cholera, and typhoid. This is undoubtedly a reflection on the state of artificial immunization against these diseases. No attempt at immunization against typhoid and cholera appears to have been made before the outbreak of these diseases. Even then the population protected is very small, being only 0.4 per cent for typhoid, the figure being still poorer for cholera. With regard to smallpox immunization figures are high as an intensive campaign for vaccination has been undertaken recently after the occurrence of two cases of smallpox. 95.2 per cent of the population have been vaccinated at least once, the percentage for males and for females being 94.6 per cent and 95.9 per cent respectively. Re-vaccination is less common, 40.1 per cent males and 29.6 per cent females being re-vaccinated. Vaccination amongst infants is fairly high; 17.9 per cent of infants under six months and 75.0 per cent infants over six months bearing marks of successful vaccination. In the age-groups 1-2 years and 2-5 years the percentages of vaccinated are 92.5 and 94.6. The table below gives the vaccination and re-vaccination results for different age groups by sexes :—

| Age in years | PERCENTAGE VACCINATED |         | PERCENTAGE RE-VACCINATED |         |
|--------------|-----------------------|---------|--------------------------|---------|
|              | Males                 | Females | Males                    | Females |
| 0-           | 44.4                  | 38.1    | 7.4                      | 4.8     |
| 1-           | 91.3                  | 94.1    | 17.4                     | 0.0     |
| 2-           | 90.6                  | 100.0   | 15.1                     | 15.4    |
| 5-           | 100.0                 | 96.8    | 38.1                     | 33.3    |
| 10-          | 97.3                  | 100.0   | 46.0                     | 42.9    |
| 12-          | 97.0                  | 100.0   | 54.5                     | 26.1    |
| 15-          | 95.8                  | 95.7    | 58.3                     | 28.3    |
| 20-          | 100.0                 | 99.3    | 49.0                     | 34.7    |
| 40-          | 94.9                  | 100.0   | 41.6                     | 35.8    |
| 60-          | 100.0                 | 97.0    | 48.3                     | 24.2    |

#### Malaria surveys

Before 1911 this area was free from malaria. Afterwards the disease spread into this area from the Burdwan side and the 1926 malaria survey revealed a fairly high spleen rate of 14.5.

The following figures of spleen rate for a few years show how fluctuating the values can be for different years :—

| Year | Spleen rate | Year | Spleen rate |
|------|-------------|------|-------------|
| 1930 | 16.6        | 1941 | 28.3        |
| 1940 | 33.3        | 1942 | 8.3         |

Past experience shows that the disease manifests itself in epidemic form once in about six years, one of the determining factors being heavy rainfall in the preceding year.

*Results of survey.*—Ninety-eight breeding places consisting of 4 tanks, 89 *dobas*, 1 pit and 4 irrigation channels were examined for larvæ. In all the 4 tanks, 3 channels and 36 *dobas*, larvæ were found; the species found being *A. vagus*, *A. hyrcanus*, *A. barbirostris*, *A. annularis*, *A. culicifacies*. The local carrier species, *A. philippinensis*, were not found in any of these breeding places.

Ninety-five places consisting of 53 cow-sheds and 42 houses were examined for the presence of adult anophelines. The species found and the number of each species caught are given below :—

| Species                | Number found | Species                | Number found |
|------------------------|--------------|------------------------|--------------|
| <i>A. annularis</i> .. | 205          | <i>A. pallidus</i> ..  | 7            |
| <i>A. hyrcanus</i> ..  | 14           |                        |              |
| <i>A. vagus</i> ..     | 9            | <i>A. barbirostris</i> | 1            |

No adults of the local carrier species were found. Of the 302 children between 2 and 12 years examined, only 6 showed enlarged spleen, the average enlarged spleen being 8.8.

Judging from past history it is doubtful if the present malaria status will continue for long and to study the importance of the malaria problem at least one more survey during the malaria season is called for.

#### Socio-economic factors

Intimately connected with any effort at Public Health Organization is the question of finance and the extent to which a community can bear the expenditure on public health. Intermingled with the economic question and oftentimes acting as a drag on progress by its conservatism are the habits and mode of living of the community. As these factors have also to be taken into consideration in appreciating the epidemiological picture of a community, a brief discussion of the socio-economic factors at Ratanpur will now be made.

Except for a few cottage industries like net making for fishing and other purposes, agriculture is the mainstay of the population, the chief crop grown being paddy. Vegetable gardening is popular and helps to supplement the income from agriculture.

The villagers lead a hand to mouth existence and being mainly agricultural and so entirely dependent on the vagaries of nature for their very existence often run into debt. It was difficult to obtain from the villagers information on family earnings though they were very co-operative in supplying detailed monthly expenditure under various heads. As such it is difficult to assess exactly as to what proportion of families were able to run the household without running into debt.

The *per capita* monthly expenditure is Rs. 8.4 and this meagre amount can hardly provide anything more than the bare necessities of life like food and clothing.

Table below gives the percentage spent on the different items by families classified according to their monthly expenditure:—

| Family expenditure in rupees (monthly) | Average monthly expenditure <i>per capita</i> (in rupees) | Food | Light and fuel | House rent and house tax | Clothing, bedding and foot-wear | Toilets | Furniture | Education | Medical advice and medicines | Travelling | Ceremonies | Debt discharge | Others |
|--|---|------|----------------|--------------------------|---------------------------------|---------|-----------|-----------|------------------------------|------------|------------|----------------|--------|
| -20                                    | 6.7   | 78.8 | 5.2            | 1.2                      | 7.0                             | 0.9     | 0.0       | 0.4       | 1.6                          | 0.8        | 0.8        | 3.2            | 0.1    |
| -30                                    | 6.7   | 78.6 | 5.1            | 1.3                      | 6.4                             | 0.9     | 0.0       | 0.6       | 3.4                          | 1.0        | 0.4        | 2.2            | 0.1    |
| -40                                    | 8.9   | 79.1 | 4.8            | 1.1                      | 6.7                             | 0.7     | 0.0       | 0.3       | 2.5                          | 1.5        | 0.5        | 2.7            | 0.1    |
| -50                                    | 8.0   | 78.0 | 4.8            | 1.6                      | 7.8                             | 0.8     | 0.0       | 0.5       | 2.1                          | 0.7        | 1.0        | 2.3            | 0.4    |
| -75                                    | 8.0   | 79.1 | 4.3            | 1.5                      | 7.1                             | 0.5     | 0.1       | 0.6       | 1.6                          | 1.4        | 1.5        | 1.8            | 0.5    |
| -100                                   | 10.2  | 77.7 | 4.1            | 1.0                      | 7.9                             | 0.8     | 0.0       | 0.7       | 1.1                          | 0.9        | 1.4        | 4.4            | 0.0    |
| -150                                   | 9.2   | 75.0 | 5.2            | 3.0                      | 6.8                             | 0.8     | 0.4       | 0.4       | 3.0                          | 1.0        | 1.6        | 2.2            | 0.6    |
| -200                                   | 12.0  | 75.0 | 3.5            | 1.0                      | 10.5                            | 1.0     | 0.0       | 1.0       | 2.0                          | 1.0        | 1.0        | 4.0            | 0.0    |
| 200+                                   | 12.4  | 81.0 | 1.0            | 1.0                      | 10.0                            | 3.0     | 0.0       | 1.0       | 1.0                          | 1.0        | 1.0        | 0.0            | 0.0    |

The bulk of the expenditure is spent on food, clothing and house rent and house tax. On an average an individual spends about Re. -[3]- per month for private medical help.

#### *Education*

There is a lower primary school in the village with 90 students on its roll but the benefit derived from it is questionable. The condition of the school is deplorable, the thatched roof having nearly given way. This school has to be run from the grant given by the District Board and the fees from the students except for small donations, but it appears that the grant from the District Board has been very irregular for the last one year. The apathy of the paid teachers caused by such treatment is reflected in the efficiency of the school.

The percentage of literacy amongst males over 15 years of age is 52.5 and amongst females of the same age group it is 3.1, literacy being defined as the ability to read and write a letter.

#### *Agriculture and animal husbandry*

The population is mainly agricultural and as in other parts of India the methods used are those handed down for generations. There is no

central organization to supply the villagers with selected strains of paddy for cultivation or to educate them in such agricultural principles as the rotation of crops, etc.

Animal husbandry is non-existent. Any public agency which would help to introduce animal husbandry and pisciculture in the villages and thus improve the economic condition and the dietary of the population would be doing a very great service.

#### *Communal activities : public health administration*

Apart from the usual facilities of the Bengal Government, the village has the advantage of coming within the sphere of activity of the Singur Model Health Unit which is financed by the Government of Bengal and the International Health Division of the Rockefeller Foundation.

The *per capita* expenditure of the health unit is about Re. -[11]- per year and its activities include—(1) environmental sanitation, (2) public health education, (3) collection and checking of vital statistics, (4) maternity and child welfare services (domiciliary and clinical), (5) school medical inspection, (6) control of communicable diseases and (7) training of public health personnel.

Considering that only 2 out of 52 births during the past year were conducted by the midwives of the health unit, the benefit that the villagers derive from this organization is questionable. The ante-natal cases in the village are also not often contacted by the health visitors. This is mostly because the villagers have all along been strangers to trained service though they are slowly overcoming their shyness.

There is no medical unit in the village. The nearest hospital is at Singur where there is an indoor hospital with 14 beds, with separate accommodation for males and females. This curative organization and the health unit meant for preventive purposes are managed by two different bodies. Only by co-operation between these two organizations can the public health problem of the area be solved efficiently.

Very few social agencies are present in the village. The existence of a primary school though not in good condition has already been referred to. There are no co-operative societies or other social welfare organizations. Even recreational facilities are limited only to the religious side of life, there being one *Bhajan Mandir* in Ratanpur.

*Recommendations to improve the welfare of the villagers*

(1) Environmental sanitation should be improved. Not only are tube-wells needed but an agency to maintain them in good condition is a greater necessity. The expenditure for sinking and maintenance could be considerably reduced if the village labour is utilized. Only supervision would be needed and the sanitary inspectors of the Bengal Health Department could be trained for this purpose. Periodical bacteriological examination of water supply is also desirable. Provision of suitable latrines is an urgent necessity. For the latter object village labour should be utilized.

(2) Effective control of communicable diseases by disinfection, immunization and better facilities for notification and isolation of cases, should be attempted.

(3) All the persons infected with hookworm should be treated and restored to normal health.

(4) The villagers should be made more conscious of public health by propaganda and the measure of success obtained should be judged by the extent to which they enjoy the facilities

of the Rural Health Unit at Singur, especially for maternity and child welfare services.

(5) The economic condition and the dietary of the people should be improved at least by the introduction of pisciculture, if not of animal husbandry. It is fully realized that in their present economic position they cannot afford to embark on this scheme by themselves. Monetary assistance in the beginning of every year for at least a couple of years would be needed and the advance should be made by co-operative banks on condition that the money advanced with a nominal interest should be returned at the end of the season. One can safely assert that if the villagers find the occupation profitable there will be no more need for persuasion.

(6) Improved strains of paddy should be introduced and a scheme for the rotation of crops should be recommended. The impetus should come from public bodies.

(7) An efficient system for the collection and checking of vital statistics should be introduced and the villagers made to appreciate the utility of early reporting of the vital events.

(8) No amount of money spent or services done can leave a lasting effect if the villagers are not genuinely interested in public health activities. Their interest can be roused and kept up only by education. So no useful attempt at improving the welfare of the villagers can be made without trying to educate the children of to-day, who shall be the citizens of to-morrow.

## Current Topics

### To Defeat the Typhus-bearing Louse

(From the *Lancet*, Vol. II, 29th November, 1941, p. 688)

THE Ministry of Health puts us on our guard against the possible arrival of louse-borne typhus in this country, in company with refugees, prisoners of war and returning travellers. The body-louse and the head-louse are both probable vectors. Diagnosis depends on the sudden onset, high temperature, the appearance on the 4th or 5th day of a rash which spares the face, and a torpid or maniacal mental state. The Weil-Felix reaction can be obtained by the end of the first week and sometimes earlier. A strong reaction in a dilution of 1 in 80 or 1 in 100, obtained by a naked-eye reading, may be taken as positive, and during the later stages of the disease the titre rises to 1 in 1,000 or even higher. At the other end of the scale, any increase in the agglutinating power of the serum, established by examinations at 2-day intervals, is significant even at a titre of 1 in 50. A vaccine against infection is available but its value in the field has not been tried. It is to be used at present only by those working on typhus teams and is to be given in three doses of 1 c.cm. at weekly intervals. If typhus does reach this country it is most liable to break out in crowded areas. Several of the large cities have been asked to organize typhus teams, each of which is to include the medical officer, 4 nurses, 1 ambulance driver, 1 ambulance attendant and 1 or more sanitary

inspectors and trained disinfectors. The team should be duplicated so that absentees can be replaced.

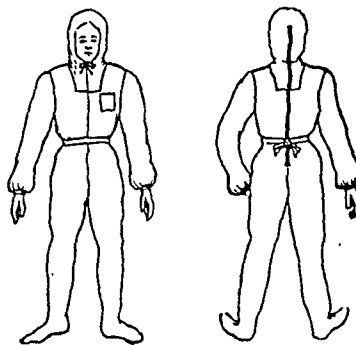


Figure shows one-piece suit for use by hospital and ambulance personnel. It is closed by means of a Zipper behind, elastic round the wrists, and a tape round the face, tied under the chin.

All team members are to be provided with protective clothing consisting of a one-piece garment with a hood fastening down the back, preferably with a Zipper. A tape runs round the face aperture of the hood and ties under the chin, and tapes and elastic draw the

sleeves closely round the wrists. Gum-boots and long fabric gloves are also to be worn, and masks if desired. Protective clothing is absolutely necessary for members of the team, since any of them may come into contact with typhus-infected lice. During removal to hospital the patient should be enveloped in a large sheet, and should travel in a vehicle which is easy to free from lice. The staff engaged in admitting the patient to hospital are particularly exposed to danger, and the greatest care of all should be taken during this time. The patient must be admitted to a special bathroom, stripped, deloused and clad in hospital clothing before being taken to a ward set aside for the purpose. Delousing must include not only complete disinfection of the patient's clothing but careful delousing of his person, close cutting of the hair, shaving where necessary and careful bathing. He must be thoroughly soaped all over and cleansed in such a way that all lice are destroyed. In the hospital a room must be provided where the staff can change into protective clothing. After use the clothing must be left there for disinfection; the staff must pass next to a bathroom and finally to the room where their ordinary clothing is kept.

Officers with experience of typhus in the medical department of the Ministry of Health or in the L.C.C. will help to advise on diagnosis, and arrangements have been made for a mobile team from the American Red Cross—Harvard Field Hospital Unit—to give help in diagnosis and control in any part of England or Wales. Medical officers of health are advised to arrange for beds to be available in the larger isolation hospitals. The origin of infection must be carefully traced and all those who have been exposed to risk must be deloused and kept under observation for three weeks. Heavily infested people may have to be deloused a second time after an interval of ten days to ensure destruction of lice hatched from surviving eggs.

### Scabies "the Itch"

(Summarized from a paper by P. A. BUXTON in the *British Medical Journal*, Vol. II, 20th September, 1941, p. 397)

THIS is a contagious disease caused by the presence on the skin of the itch mite *Sarcoptes scabiei* de Geer.

**Ætiology.**—All ages are susceptible to this disease and both sexes are equally affected. In peace time children are the worst sufferers. They get the infection from other children at school and then spread the disease to their families. Next to the children, people attending to the animals—horses, sheep, pigs and dogs—get the infection from the animals, and spread the disease through their families. The disease spreads rapidly in places where there is overcrowding. Amongst labourers and troops the disease is brought from families and spread amongst the fellow workers and troops.

***Sarcoptes scabiei*: Appearance.**—The female mite is about 0.390 mm. long and the male 0.225 mm. The general outline of the itch mite is oval: it is convex above and flat below and of dirty white colour. The adults and nymphs have four pairs of legs and the larvæ three pairs. The anus is terminal. The legs are short; in the female the first and second legs terminate in suckers (ambulacra), in the male there are similar suckers on the first, second and fourth legs. The male has large and elaborate genital organs lying on the ventral surface between the fourth pair of legs. Anatomically the mites attacking man, horse and the common pets are not to be distinguished.

**Life cycle of the *Sarcoptes scabiei*.**—Much of the life cycle is passed beneath the surface of the skin of the host. The adult female usually lives in the burrows made by the nymph, but removed from her burrow she is capable of burying herself again completely in a very brief period. Usually the burrows are made in the parts of the body where the skin is thin, for example the webs between the fingers, the flexor surfaces of the wrists, etc. Once beneath the skin the

mite rests if the body is cold and continues to excavate its burrow only if the skin is warm. It is when the mite is wandering on the skin that the itching is felt so it is worse in the night when the patient's body is warm under the cover of the blankets. Within 24 hours of maturing the female lays the first egg.

The duration of the successive stages from the hatching of the egg to the emergence of an adult female is as follows:—

Eggs—2½ days or more; larva—1½ to 3 days; nymph—1½ to 2½ days; immature female—2 to 4 days. The shortest period from the deposition of eggs to the emergence of adults may be just short of eight days. The larva quits the burrow of its parent in which it hatched from the egg and makes its own burrow. The nymph in its turn makes its own burrow. It is not known whether the males and the immature females make their own burrows or continue in that made by the nymph. The adult female does not normally move though she can start a fresh burrow if she is forcibly removed from her burrow.

The itch mite cannot survive long outside the skin burrow of the host and it seems probable that she lays rather more than two eggs daily to a total of about forty to fifty.

**Hosts.**—Mites similar to that of *S. scabiei* of man causing itching and mange occur on the horse, dog, sheep, rabbit and other animals. Anatomically these mites are not separable from one another and it is customary to speak of varieties such as *S. scabiei* var. *hominis* on man, var. *equi*, *canis*, *suis*, *ovis*, on the horse, dog, pig and sheep and so on.

**Transmission.**—There is no doubt that one human being is normally infected from another, the itch generally spreads through a family or a group of man living together. Scabies infection has also been traced to domestic animals such as horses, dogs, cats and rabbits. Its spread through the fomites has not been proved definitely, but for all practical purposes the fomites are recognized as a source of infection and should be treated as such.

The severity of the scabies acquired by man from animals differs greatly with circumstances. Mites derived from camels appear to be particularly irritating. Some of the cases of crusted scabies in man may be derived from animals.

**Medical importance.**—It is very important to detect scabies, segregate the patients and treat them effectively in order to stop further spread of the disease. In conditions of war its spread among labourers and troops should be prevented because it causes loss of time and impairment of efficiency in the men due to lack of sleep owing to the intense irritation at night. Its spread amongst school children is very rapid and causes a good deal of suffering.

**Symptoms.**—The cardinal symptom is the intense itching especially at night. The mites wander about in the night to make fresh burrows when the body surface is warm, that is when the patients cover themselves with blankets. In the tropics patients complain of itching both in the day and night but the irritation is always worse at night. The scabietic child looks pale, heavy-eyed and is irritable. Left untreated for some time the lesions become infected with secondary pyogenic organisms such as strepto- and staphylococci and an inflammatory condition supervenes. The hands, feet and buttocks become covered with painful pustules and there is often inflammation and fever. Nephritis is a frequent sequela due to a large skin surface being infected with streptococci.

**Crusted scabies or Norwegian crusted scabies.**—This is a distinct clinical condition with thick crusts and callosities on the various parts of the body, especially the limbs. The crusts which are stratified may project 2 to 3 mm. above the surface of the skin and consist of dead epithelium, dried exudate and enormous numbers of sarcoptes of all stages. Generally the condition requires at least a year for its development and when fully established gives the appearance of sarcoptic mange such as one sees in the dogs. The hands are more affected than other parts. The condition is very



rare. It is more common in lepers. Diverse views are held as to the cause of this condition. Many authors regard the disease as normal scabies which has been neglected perhaps because it occurs in insensitive lepers or in careless patients. The alternative view is that the mites in crusted scabies are derived from animals. From the reports on the mites from a crusted scabies in a Chinese leper it was clear that these mites differed in several important characters from the ordinary human variety. It may be that both the above views are correct.

**Treatment.**—A. The traditional treatment for scabies is the *unguentum sulphuris* B.P. 1 dr. to 1 oz. Its effectiveness is indisputable and it is very well suited for treatment in the outpatient department where large numbers of patients have to be dealt with economically and because of the simplicity of the method of application.

The patient is given a good wash with soap and warm water—the skin surface is scrubbed well with a hard brush or a rough flannel; the wash is given preferably towards evening. He is then given a quantity of the ointment sufficient to cover his whole day (about 3 ounces of ointment is required for one application for every adult); this he rubs in vigorously for twenty minutes to half an hour and then puts his clothes on and goes to bed.

This process is repeated for three consecutive nights and on the morning of the 5th day he gets a good bath and wears fresh clothes and the treatment is complete. His clothes and bed-sheets that he was using during the four days of treatment should be thoroughly sterilized by boiling.

This method of treatment though simple and efficient is not without some disadvantages, such as (1) The use of an ointment spread thickly over the body means that underclothing and bedding become soiled by the grease. (2) Greasy ointment combined with its pungent smell is objectionable to many people. (3) All the burrows must be opened by preliminary scrubbing otherwise the ointment cannot penetrate. (4) There is likelihood of sulphur dermatitis.

#### B. Sulphur soap method.

The application of sulphur incorporated in a soap has been used in America fairly extensively in recent times with good results. It is a cleaner method than the messy ointment and the actual quantity of sulphur used for each case being less than that in the ointment. It gives less chance of sulphur dermatitis and it helps the saving of sulphur.

The technique is as follows:—Sulphur in the strength of 18 per cent is mixed with a bland soap (in America soft soap is being used) and made up into tablets of 4 grammes each—which is the amount of soap required to cover the body with lather. (1) The patient is given a good hot bath and scrubbed well with a nail brush or harsh flannel. (2) Then the body is lathered all over with the soap, the foam being produced by rubbing the tablets between the nurses' wet hands. (3) The lather is allowed to dry. (4) Clean clothes put on. (5) This procedure is repeated on two successive days. (6) The clothes and bed-sheets are boiled. (7) If any irritation or excoriations are present *unguentum zinci*, B.P. or calamine ointment is given to apply for the next few days.

This method though quite effective and clean requires an intelligent person to carry out the instructions, which is not possible in a large outpatient clinic.

#### C. Benzyl benzoate emulsion.

This method of treatment is very well suited for mass treatment as in the army. The technique is as follows:—Each patient receives a hot bath and the body is well lathered with soap and scrubbed. When the skin is dry the whole body surface from the neck to the toes is covered with an emulsion containing equal parts of benzyl benzoate, soft soap and aethylated or rectified spirit (Proscabin-Bayer) applied with a brush. Parts badly affected receive a second painting immediately after the first has dried. The previously worn clothing is then put on. Bath and painting is given on the second day and clean

underwear used. The patient is advised to have the clothes and bed-sheets changed and disinfected. The crusted or pustular areas of secondary infection are treated with 1 per cent ammoniated mercury ointment after completion of the benzyl benzoate treatment. Each patient is examined after 4 days or 1 week and if necessary a second course of treatment is given, as above. This treatment requires the help of another man or a nurse and hence only suitable for inpatients in the hospital and for the army.

L. M. GHOSH.

## Reviews

**EXERCISES IN ELECTROCARDIOGRAPHIC INTERPRETATION.**—By Louis N. Katz, A.B., M.D. 1941. Henry Kimpton, London. Pp. 222. Illustrated with 128 engravings containing 189 electrocardiograms. Price, 25s.

In this book the author has presented an outline of the manner in which to study and interpret an unknown electrocardiogram, and this has been followed by a series of 90 case records. The description and interpretation of each appears on the page opposite to the electrocardiogram and a brief clinical history and series of electrocardiograms taken at different intervals when necessary, are set forth, so that the reader may compare his own interpretation with the author's and correlate the clinical aspects of the cases with electrocardiographic patterns.

The interpretations are based on the teaching in the author's book on electrocardiography. The tracings are well chosen and represent a wide variety of cardiovascular disorders.

The book will be found very useful by the student of cardiology in that it will provide a guided practice in reading and interpreting electrocardiographic records.

P. C. S. G.

**ELECTROCARDIOGRAPHY INCLUDING AN ATLAS OF ELECTROCARDIOGRAMS.**—By Louis N. Katz, A.B., M.D. 1941. Henry Kimpton, London. Pp. 580. Illustrated with 402 engravings, including 806 electrocardiograms. Price, 45s.

It is almost a century since it was first observed that twitches of the rheoscopic frog-muscle preparation accompanied the contractions of the heart. Since then, there has been a gradual evolution in the methods of recording and interpreting these cardiac action currents, until the electrocardiogram came into clinical prominence. More recently, a new era has begun with the introduction and development of the clinical use of chest leads, and in the diagnosis and management of coronary disease.

Here is a comprehensive treatise on electrocardiography with an admirable presentation of the subject, emphasizing all its practical aspects along with enough theoretical background to facilitate an intelligent interpretation.

The book is divided into three sections. The first section deals with the theory of electrocardiography with brief accounts of galvanometers, available types of electrocardiographic machines, equipment and technique. In discussing the chest leads the author has presented the recommendations of the joint committee of the American Heart Association and the Cardiac Society of Great Britain and Ireland. Ordinarily, he prefers to take two chest leads CF<sub>1</sub> and CF<sub>2</sub>, labelled '4' and '5' in the records for information not ordinarily demonstrable in limb leads. In discussing the place of electrocardiogram in clinical practice, the author says 'the electrocardiograph is not a tool for the unscrupulous or a plaything for the erudite, nor is it an instrument of precision which replaces the ordinary clinical examination. . . . It is as much of an

error to expect too much from this tool as to ignore the valuable information that it can give'.

The second section describes the normal electrocardiogram and the range of its variations. The normal U wave is considered in the present state of knowledge to be of unknown clinical significance. Table I is a very useful one depicting the characteristics of the normal electrocardiograms. This is followed by discussions on abnormal electrocardiograms which include the changes that occur during administration of drugs and in various diseases, acute or chronic. The changes due to coronary disease have been dealt with in detail.

Section three is devoted to systematic description of the electrocardiogram in the arrhythmias.

Each section is followed by an extensive bibliography. There are numerous excellent, well-chosen and explicit illustrations which, along with the legends beneath each, serve almost as an atlas on the subject. The book is of a high standard and the cardiologist will find it an invaluable aid in his practice.

R. C.

**SURGERY OF THE HEART.**—By E. S. J. King, M.D., M.S., D.Sc. (Melb.), F.R.C.S. (Eng.), F.R.A.C.S., Major, R.A.M.C. 1941. Edward Arnold and Company, London. Pp. xii plus 728. With 268 illustrations. Price, 50s.

THIS is a book of rare merit and is a timely publication. It may be included in the surgery of modern warfare.

The text is divided into two main sections, of which the first deals with the anatomy, histology and physiology of the heart with a brief review of electrocardiographic and radiological methods of investigation. The other section, dealing with the treatment of cardiac diseases, is divided into three parts: (i) general methods and principles of surgical approach, (ii) experimental work, and (iii) diseases and their treatment.

This monograph is based on the Jacksonian essay of the Royal College of Surgeons for the year 1938. Surgery of the heart is a very difficult subject but the author has succeeded in compiling a great work, which is assured of a ready welcome. No one will dispute the statement that the surgeon who would attempt the treatment of diseases of the heart must have the courage and optimism of the explorer and be equipped to justify their exploitation. The printing, get-up and illustrations are all excellent. The book is provided with a large bibliography and an adequate index, which will be greatly appreciated.

P. N. R.

**THE PROBLEM OF TUMOURS—AN EXPERIMENTAL INVESTIGATION.**—By J. C. Mottram, M.B. (Lond.). 1942. H. K. Lewis and Company, Limited, London. Pp. vii plus 91 with 9 tables and 33 illustrations. Price, 7s. 6d. (Paper boards).

PERHAPS no branch of scientific medicine is more perplexing and fascinating than the problem of tumours. At the same time the subject is extremely important because the number of fatalities and invalidism is enormous. Up to the present day the explanation for causation of tumour formation is a mystery; from time to time various theories were advanced but they all remained in the domain of conjectures.

In this small volume Dr. Mottram has put forth the observations as seen in the course of experimental investigations of tumour formation. He has observed the phenomenon of photo-dynamic activity of benzopyrene on paramecium and its power of increased cellular proliferation. This has opened a new field of investigation, viz, the factors that can cause increased cellular multiplication. The physico-chemical processes as described by the author are highly interesting and perhaps continued researches on this line might throw some light on the explanation of tumour formation. It is gradually becoming evident that the

medical biologists will have to look forward to the chemists and physicists for the solution of their problems. The experiments of Dr. Mottram will be keenly watched by the scientific world with great expectations.

B. P. T.

## Abstracts from Reports

### ANNUAL REPORT FOR 1941 OF THE BENGAL BRANCH OF THE BRITISH EMPIRE LEPROSY RELIEF ASSOCIATION

#### WORK DONE

THE chief lines of work followed during the present year have been as follows:—

*Leprosy survey.*—In the past leprosy survey work has been of the nature of sample surveys and covering large areas in a limited time.

During recent months, attempts have been made to organize survey work of a more thorough nature in limited areas in such a way as to give accurate information. Such surveys have been carried out during the present year in the following districts: Tippera, Hooghly, Bankura, Malda, Rangpur and Birbhum. Work is now being done in Rajshahi.

*Training of doctors.*—Under the auspices of the Bengal Branch a special post-graduate course in leprosy lasting for eleven days and attended by 18 doctors deputed by the district authorities in Bengal was held in the Leprosy Department of the School of Tropical Medicine, Calcutta, under Dr. Lowe. Three short courses have been held by Dr. B. N. Ghosh, the leprosy officer, during this year, one in Midnapore and two in Rangpur. These three courses have been attended by 47 doctors. Other similar work has been planned in Rajshahi in December. Three days' instruction was also given for clinic assistants in one district.

*Visits to clinics.*—There are about 139 leprosy clinics in the districts of Bengal and visits from our staff help to maintain a reasonable standard of work in these clinics.

*Detection of cases of leprosy in school children.*—During the year, 10 teachers' training schools with 864 students and 41 other schools with 9,102 students have been visited, and the staff and students of these schools have been examined. During this work 44 cases of leprosy have been detected giving an incidence of approximately 0.44 per cent. Lectures on leprosy have been delivered in 23 of the schools visited.

*Examination of the police.*—At the request of the district authorities in two districts our staff examined the police force of these districts, the total number being 1,598. Among these, 39 cases of leprosy had been detected giving an incidence of 2.4 per cent. Practically all the cases detected, however, have been of very mild type which does not progress, is not infectious and causes no serious disability.

*Leprosy in jails.*—At the request of one district authority the jail prisoners were examined numbering 906. Among these 19 cases of leprosy were detected giving an incidence of 2.2 per cent, most of the cases being mild.

*Propaganda work.*—A complete new set of slides for popular lectures has been prepared and a lecture drafted to go with them. New models illustrating the main points about leprosy from the public health standpoint have been devised. New pamphlets on leprosy for use among general public and in schools have been prepared and are being produced in English, Hindi and Bengali. The work included lectures on leprosy, health exhibitions and a radio talk.

Arrangements have been made with the Director of Public Instruction and the Director of Public Health,

Bengal, for the development of leprosy propaganda in high schools throughout the province. The work done this year in schools has already been mentioned.

*Study of leprosy in Calcutta.*—It has been felt desirable to obtain more information about leprosy and the spread of leprosy in the general population of Calcutta. One of the assistant leprosy officers has therefore been deputed to study this problem. The findings of this work so far indicate that while leper beggars in Calcutta and neighbourhood may number 1,000, the number of cases in the general population is probably at least ten times this figure, that a considerable number of the cases are infectious, and that a considerable number of persons have acquired the disease in Calcutta.

*Study of leprosy in women and children.*—For the detection of cases in females—a woman assistant leprosy officer has been appointed under the Branch.

#### DISTRICT BRANCHES

The following local organizations in Bengal are affiliated to the provincial branch:—(1) Bankura district leprosy council, (2) 24-Parganas district branch, (3) Silda Peddie leper clinics (Belpahari, Midnapore district), and (4) Murshidabad district branch. There are other anti-leprosy organizations in Bengal and their affiliation to this Branch is being encouraged.

#### FINANCE

The audited accounts of receipts and payments for the year 1941 show that payments have exceeded receipts by about Rs. 2,300 and that the balance has been reduced from Rs. 16,684-12-3 to Rs. 14,382-9-0. Nevertheless the financial position of the branch remains sound; but if the work is to be continued on the present scale, additional income will be needed later.

#### REPORT OF THE WORKING OF THE PUNJAB MENTAL HOSPITAL, LAHORE, FOR THE YEAR 1941

*Total population.*—The year 1941 opened with 1,128 patients (902 men and 226 women) and closed with 1,169 (929 men and 240 women). The total number of patients treated in the hospital during the year under report was 1,416 as against 1,366 in 1940 and the daily average strength rose from 1,090.84 in 1940 to 1,143.43. It has been possible to reserve

accommodation up to 100 patients for military insanes belonging to this province.

*Admissions and discharges.*—The number of admissions and re-admissions was 252 (204 men and 48 women) and 36 (29 men and 7 women) respectively as against 289 (236 men and 53 women) and 42 (38 men and 4 women) in the preceding year. The total number of discharges was 195 (165 men and 30 women), viz, 89 cured, 59 improved, 29 not improved and 18 otherwise as against 117, 27, 42 and 21 respectively in the preceding year. The total number of deaths was 52 in 1941 as against 31 in the previous year. The percentage of deaths on the daily average strength and on admission was 4.54 and 4.51 as against 2.84 and 2.42 respectively in 1940.

*Health of patients.*—There was no outbreak of an epidemic nature and the general health of patients during the year under report was satisfactory. The chief treatment for mental disorders done in the hospital is with cardiazol, ammonium chloride, and sulphosin. These treatments were carried out with encouraging results. The occupational therapy such as agriculture, gardening, weaving, munj matting, etc., continues to be the main feature of treatment.

Of the total number of 288 admissions 155 were Hindus (122 men and 33 women), 114 Muslims (97 men and 17 women), 1 European, 10 Indian Christians (6 men and 4 women), and 8 others (7 men and 1 woman) as against 166 Hindus, 151 Muslims, 8 Indian Christians and 6 others in 1940.

The principal types of insanity among the patients treated in 1941 and 1940 are compared below:—

|  | 1941 | 1940 |
|--|------|------|
| (1) Manic depressive insanity ..               | 344  | 349  |
| (2) Schizophrenia including dementia præcox .. | 358  | 358  |
| (3) Secondary dementia ..                      | 136  | 143  |
| (4) Mental deficiency ..                       | 138  | 129  |
| (5) Epilepsy and epileptic insanity ..         | 136  | 119  |
| (6) Mania ..                                   | 95   | 67   |
| (7) Paranoia and paranoid states ..            | 68   | 63   |
| (8) Cannabis indica psychosis ..               | 51   | 50   |
| (9) Melancholia ..                             | 39   | 45   |

*General.*—The non-official visitors took keen interest in the welfare of the patients, especially Mrs. Bharucha whose name is worthy of special mention in this connection.

## Correspondence

### LOCAL CHEMOTHERAPY OF WOUNDS

SIR,—For the last six months I have been trying sulphanilamide locally, either in powder form or sometimes in the form of a 3 to 5 per cent ointment with sterile vaseline, mostly in dressing infected wounds with a fair amount of sloughs in them. I had a mind all along to assay properly the merits of topical application of sulphanilamide, *vis-à-vis* the acriflavine ointment dressing, in these cases. Of course, till very recently sulphanilamide in my hand could not prove to be the better substitute, though verily it was never a failure either.

Recently for about a month I have made a little alteration in its mode of use by adding cod-liver oil (pure) to my usual formula of its ointment, whereby now I find its bactericidal effect definitely enhanced in comparison with its previous result.

Lately, apart from suppurating wounds I have tried it with very encouraging results in a good many cases of impetigo contagiosa, pustular eczema, and some obstinate cases of paronychia that baffled practically all other methods of local treatment.

In all my cases treated so far, I have used only 'septanilam' brand of sulphanilamide in the following prescription:—

R Septanilam .. .. grs. 20  
Oil morrhuae .. .. drachms 2  
Lanoline ad .. .. 1 ounce  
Fiat unguentum

J. C. BISWAS, L.M.F.,  
Assistant Medical Officer,  
South Dum Dum Municipality.

DUM DUM,  
18th April, 1942.

### CHEMOTHERAPY IN BACILLARY DYSENTERY

SIR,—I read with interest Dr. D. Lapping's article on 'Chemotherapy in Bacillary Dysentery', in the last February copy.

I have had the chance of treating eleven cases of bacillary dysentery with Dagenan, with no mortality

and highly satisfactory results. Some cases were very toxæmic on admission. On the second day of treatment the patients generally felt better and rapid cure followed. The general line of treatment followed here is Dagenan 2 tablets, *i.d.*, for adult and children proportionately; with free alkaline *cum* glucose drink. Bael Sherbet in the early morning was supplied, as this is noted to turn the stools formed early. A dose or two of Dover's powder were needed for the bad cases.

S. C. GUHA ROY, L.M.F.,  
Assistant Medical Officer,  
Borbheel Tea Co., Ltd.,  
Borgang P. O., Assam.

4th April, 1942.

### THE ASSESSMENT OF VITAMIN NUTRITION

SIR,—In his article on 'The Assessment of Vitamin Nutrition' published in the *Indian Medical Gazette* of March 1922, Dr. N. C. Datta writes (line 10, p. 157, column 1), 'They found the daily excretion of most of the normal individuals whom they examined to lie between 150 to 240 mg. Westenbrink and Goudsmit (1938) are of opinion that individuals excreting over 100 mg. of vitamin B<sub>1</sub> are saturated with the vitamin' (italics mine).

I am surprised to read this statement and should be interested to learn the diet that these normal people consumed. So far as I know, no dietary in the world supplies such large amounts of vitamin B<sub>1</sub> and even the most liberal standard of the human requirements of this vitamin lies somewhere between 2 to 3 mg. Obviously, what is meant is international units and not milligrams in the above statement. But the error does not appear to be a misprint or a mere slip of pen, for, in column 2 line 20, we read, '... a value of 4.5 mg. per 100 c.cm. or less for human blood is considered to be significantly low' (italics mine).

Even at best, this is a careless statement and I should not have thus protested but for the fact that similar errors had also crept in Sir R. N. Chopra's article which appeared in the February number.

K. A. SHAH, M.B., B.S.

RANCHHODLAL DISPENSARY,  
PANCHKUWA, AHMEDABAD,  
28th April, 1942.

### TRICHLORETHYLENE

SIR,—I am made to understand by medical colleague of mine that trichlorethylene is as useful if not more pleasant as tetrachlorethylene or carbon tetrachloride. But no suggestion of such drug is being seen in your editorial of March 1942.

I shall be pleased if you will kindly reply me whether 'trichlorethylene' is advocated in the latest edition of Manson-Bahr.

C. MATHAI.

KADAMANKULAM ESTATE,  
MUNDAKAYAM P. O.,  
S. INDIA,  
18th April, 1942.

[Note.—Trichlorethylene is used in industry as a fat solvent and numerous cases of intoxication have been reported from workers exposed to the vapours of this compound. Cases of acute poisoning have been reported in men using trichlorethylene to remove grease from machinery.

Animal experiments with this compound have shown that it has very little action against hookworms (Wright, W. W., 1932, *Amer. Journ. Hyg.*, 16, 2, 325).

Probably this letter refers to the editorial of March 1941 in which hookworm infection was discussed, and not to that of March 1942 which was on industrial hygiene. Was our correspondent's mistake an inspired

one, because trichlorethylene appears to be more important from an industrial hygiene point of view than from an anthelmintic?

This drug is advocated in the last edition of Manson's Tropical Medicine.—EDITOR, I. M. G.]

### KNOWLEDGE OF SEX

SIR,—The comments on the sociological importance of sexual knowledge of Indians by Lieut.-Colonel O. Berkeley-Hill, I.M.S. (Retd.), in his article 'A Case of Mild Hypopituitarism' appearing in March 1942 number of the *Indian Medical Gazette* have neither been based on facts nor fairly drawn. It appears obvious that the author has tabooed Indians unjustly.

Although he has not given out what is the importance of sexual knowledge but it is true that procreation is the chief object and that its natural instinct common to mankind, irrespective of colour, creed and climate. It is the primitive quality of mankind, none having monopoly over it, unaffected hitherto by any sort of influence from any quarter.

India's population, according to last several censuses, has shown continuous increase. In spite of anxiety of the author, Indians are not dissatisfied with their ideals of plain living and high thinking. Would it be too much to expect that authors will save the trouble of making needless comments on racial knowledge of sex when they can easily do without those.

K. DUTT,  
Honorary Secretary,  
24-Parganas Branch,  
All-India Medical Licentiates'  
Association.

9-B, ROYPARA BYE LANE,  
COSSIPORE,  
CALCUTTA,  
24th April, 1942.

## Service Notes

### APPOINTMENTS AND TRANSFERS

LIEUTENANT-COLONEL G. H. MAHONY, I.M.S. (retired), is temporarily appointed as Civil Surgeon, Darjeeling, for a period of 1 year, with effect from the 3rd February, 1942.

His Excellency the Governor of Bengal is pleased to appoint Lieutenant-Colonel G. H. Mahony, I.M.S. (retired), Civil Surgeon, Darjeeling, as Honorary Surgeon to His Excellency at Darjeeling, with effect from the 3rd February, 1942.

On reversion to military duty of Lieutenant-Colonel V. R. Mirajkar, O.B.E., Professor of Surgery, and Principal, K. E. Medical College, Lahore, Lieutenant-Colonel S. N. Hayes, Professor of Midwifery, assumed collateral charge of the office of Principal of the College on the afternoon of the 15th April, 1942, and Lieutenant-Colonel A. S. Fry, Professor of Operative Surgery, assumed charge of the office of Professor of Surgery in addition to his own duties on the hour and date mentioned above.

On return from leave Major F. R. W. K. Allen resumed charge of the office of Civil Surgeon, Raipur.

### INDIAN LAND FORCES

#### (Emergency Commissions)

The undermentioned Lieutenants (on probation) are confirmed in their rank, with effect from the dates specified:—

M. Alam. Dated 1st August, 1940.

S. K. Ghosh. Dated 2nd December, 1940.

A. R. Biswas. Dated 25th March, 1941.

B. K. Sheorey. Dated 23rd June, 1941.  
The undermentioned appointments are made :—

*To be Lieutenants*

James Elliott Moncreiff Melville. Dated 29th November, 1941, with seniority from 29th November, 1940.

Hugh Rosborough Swanzy Harley. Dated 29th November, 1941, with seniority from 29th November, 1940.

Owen Clarke. Dated 20th December, 1941, with seniority from 20th December, 1940.

Duncan MacAulay. Dated 20th December, 1941, with seniority from 20th December, 1940.

Archibald James Sinclair. Dated 20th December, 1941, with seniority from 20th December, 1940.

Kenneth James Langlands Scott. Dated 20th December, 1941, with seniority from 20th December, 1940.

William Francis John Maxwell Thom. Dated 20th December, 1941, with seniority from 20th August, 1940.

George Edwin Spear. Dated 20th December, 1941, with seniority from 20th June, 1940.

Norman John McQueen. Dated 20th December, 1941, with seniority from 20th June, 1939.

Alastair Colon Mackenzie. Dated 20th December, 1941, with seniority from 20th June, 1940.

Danier Crawford Logan. Dated 20th December, 1941, with seniority from 20th June, 1940.

**PROMOTIONS**

Lieutenant-Colonel P. D. Chopra (now on military duty) has been advanced to the higher position of his rank, with effect from the 14th October, 1941.

Lieutenant-Colonel A. S. Fry, Professor of Operative Surgery, K. E. Medical College, Lahore, has been advanced to the higher position of his rank in the increased pay admissible, with effect from the 22nd November, 1941.

Captain F. V. Stonham has been promoted to the rank of Major, with effect from the 1st February, 1942.

**INDIAN LAND FORCES**

*(Emergency Commissions)*

*Lieutenants to be Captains*

M. Alam. Dated 1st August, 1941.

S. K. Ghosh. Dated 2nd December, 1941.

1st March, 1942

|                      |                     |
|----------------------|---------------------|
| S. L. Sawhney.       | T. M. Rao.          |
| D. N. Vora.          | S. Krishnamurti.    |
| K. Minakshisundaram. | L. C. Waderha.      |
| S. S. Kapur.         | F. N. Shroff.       |
| B. N. Trilokekar.    | A. P. K. Ramamurti. |
| P. N. Rao.           | M. Z. Y. Hussain.   |
| M. Jegaroyan.        | B. P. Sinha.        |
| S. K. Ghosh.         | P. G. Rau.          |

C. T. Shah.

J. N. Ghosh. Dated 2nd March, 1942.

15th March, 1942

|                   |                  |
|-------------------|------------------|
| N. S. Reddy.      | T. K. Narayanan. |
| M. A. Haq.        | A. Ahmed.        |
| J. N. Mukherjee.  | P. K. K. Menon.  |
| B. Bhattacharyya. | K. V. Pillai.    |
| K. C. Mukherjee.  | H. P. Mehta.     |
| S. M. Khan.       | S. Bynan.        |

A. Haq.

16th March, 1942

|                  |              |
|------------------|--------------|
| M. M. Singh Roy. | R. C. Mitra. |
| P. Ramamurti.    | N. G. Kar.   |

B. Mahadevan.

H. L. Marathe. Dated 17th March, 1942.

**RETIREMENTS**

Lieutenant-Colonel K. S. Thakur. Dated 2nd April, 1942.

Lieutenant-Colonel H. S. Anand. Professor of Physiology, K. E. Medical College, Lahore, who was

on military duty since 15th July, 1941, has been invalidated out of the service, with effect from the 13th February, 1942.

The following retirement, with gratuity, is permitted :—

**INDIAN LAND FORCES**

*(Short Service Commission)*

Captain C. Parkash. Dated 7th March, 1942.

## Notes

### CLINICAL EXPERIENCES WITH UREA SULPHAZIDE

We have received a copy of a brochure on *Clinical Experiences with Urea Sulphazide* by Union Drug Company, Limited.

It is a soluble azo-compound of the sulphanilamide group, in which sodium is replaced by urea.

The brochure is a collection of articles on the uses of the compound. Copies can be obtained free from Messrs. Union Drug Company, Limited, 285, Bow Bazar Street, Calcutta, by the members of the medical profession.

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## Original Articles

### INFLUENCE OF ANTI-ANAEMIC TREATMENT ON THE GASTRIC FUNCTION IN HOOKWORM DISEASE

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THE usual conception of the connection between anaemia and stomach function is that certain pathological conditions of the stomach cause anaemias. The inability of the stomach to form Castle's intrinsic factor which is necessary to build the anti-anaemic or anaemia-preventing factor from the extrinsic factor is one of the main mechanisms leading to pernicious anaemia. Deficiency of hydrochloric acid in the gastric juice is said to impair the utilization of the food iron, which is necessary to prevent the formation of normoblasts that are deficient in haemoglobin; in the absence of sufficient iron, hypochromic anaemias develop.

Which correlation exists the other way round? How is the stomach function influenced by changes in the blood condition? This question was touched on in one of the important investigations by Napier and Das Gupta (1935-37), which form in their totality a rich source of information. These authors examined the distribution of the different degrees of acidity among different kinds of anaemias and compared these findings with those in 'normal' Indians; but only in two cases was it possible to examine the influence of anti-anaemic treatment or of an improved blood condition on the stomach function. McRobert *et al.* (1940) performed similar investigations; they report that in four achlorhydric ancylostomiasis anaemias, free hydrochloric acid appeared after anti-anaemic treatment, whereas three other cases of the same kind remained achlorhydric; no figures of the gastric acidity are given regarding these cases. Finally, Napier, Das Gupta and Majumdar (1941) examined the gastric acidity of 28 cases of hookworm anaemia.

These papers supply valuable material for the comparison of the distribution of the various acidity levels in *untreated* hookworm anaemia with our cases; but in none of these investigations was the variation of the gastric function with the improving blood condition systematically followed up, so that practically nothing is known about the correlation between haemopoietic and stomach function in hookworm anaemia under anti-anaemic (iron) treatment.

The following working method was used to investigate this question in 51 hospital patients (43 men, 8 women) suffering

from hookworm anaemia; erythrocyte count, haemoglobin level (Sahli Haemometer, 'Amsco', U.S.A., 100 per cent = 15 g.) and gastric acidity with fractional test meal have been estimated on admission. From these 51 cases, 37 were selected for further investigation; the selection depended on the following points: the patient had to promise to stay at the hospital as long as required 'to kill his worms'; he had to be afebrile and clinically free from any other active disease; the haemoglobin content on admission had to be not more than 20 per cent (one case with Hb. 25 per cent was included). In these cases the same estimations (erythrocyte count, haemoglobin per cent and fractional meal with oatmeal gruel) have been performed simultaneously on admission and during anti-anaemic treatment at weekly intervals until a haemoglobin level of about 30 to 40 per cent (preferably 40 per cent) was attained; usually three to four weeks of treatment were needed to reach this haemoglobin level; only three patients out of this series left the hospital with a lower haemoglobin value. Then followed anthelmintic treatment. The anti-anaemic treatment uniformly consisted in iron medication (freshly prepared Blaud's pills, 90 grains per day); no other remedy was given and to avoid any external influence on the gastric function, the iron medication was stopped 36 hours before each test meal. Every sample of gastric juice, recovered before and in half-hourly intervals during the test meal, was unfiltered, titrated against  $\frac{N}{10}$  NaOH with dimethylamidoazobenzol as indicator for the estimation of free HCl and phenolphthalein for the total acidity; whenever a sufficient quantity of gastric juice was evacuated, a simple and exact colorimetric method was applied to estimate the pH (Michaelis and Mueller, 1922).

The diet of the investigation cases was milk and bread during the first two weeks; later on, most of them were given, in addition, unpolished rice and buttermilk; a few of them also butter and eggs.

Among the 51 cases of hookworm anaemia examined on admission, 11 = 22 per cent are achlorhydric, 14 = 28 per cent hypochlorhydric (free HCl below 25), 13 = 25 per cent normochlorhydric (free HCl 25 to 45) and 13 = 25 per cent hyperchlorhydric (more than 45 free HCl); we do not calculate the percentage for male and female patients separately because the female group, containing eight patients, is too small to yield exact results.

The results of the examinations of the 17 followed-up patients are given in table I.

Calculating the distribution of acidity groups for the 37 investigation cases, 17 of which are reported in table I, we get the following results, taking the same group limits as for the total of 51 cases: achlorhydric 7 = 19 per cent, hypochlorhydric 10 = 27 per cent, normochlorhydric 11 = 30 per cent and hyperchlorhydric 9 = 24 per cent.



TABLE I

Showing hæmoglobin per cent, free HCl, total acidity and pH of 17 cases of hookworm anæmia, examined on admission and during anti-anæmic treatment

| Case number                       | ON ADMISSION |          |               | DURATION OF IRON MEDICATION |          |               |         |          |               |         |          |               |                  |          |               |
|-----------------------------------|--------------|----------|---------------|-----------------------------|----------|---------------|---------|----------|---------------|---------|----------|---------------|------------------|----------|---------------|
|                                   |              |          |               | 1 week                      |          |               | 2 weeks |          |               | 3 weeks |          |               | 4 weeks          |          |               |
|                                   | Hb.%         | Free HCl | Total acidity | Hb.%                        | Free HCl | Total acidity | Hb.%    | Free HCl | Total acidity | Hb.%    | Free HCl | Total acidity | Hb.%             | Free HCl | Total acidity |
| <i>Achlorhydria : 7 cases</i>     |              |          |               |                             |          |               |         |          |               |         |          |               |                  |          |               |
| 1                                 | 14           | 0        | 2/10          | 14                          | 0        | 2/6           | 20      | 0        | 4/6           | 27      | 0        | 4/8           | 35               | 0        | 4/4           |
| 2                                 | 15           | 0        | 4/10          | 19                          | 0        | 4/8           | 36      | 0        | 2/6           | 38      | 0        | 2/10          | 45               | 0        | 4/8           |
| 3                                 | 11           | 0        | 4/10          | 15                          | 6/10     | 6/26          | 25      | 0        | 4/10          | 31      | 0/6      | 2/12          | 40               | 2/20     | 4/26          |
| 4                                 | 15           | 0        | 4/16          | 18                          | 0/34     | 4/40          | 18      | 0        | 8/14          | 28      | 0/48     | 4/56          | 36               | 0        | 4/32          |
| 5                                 | 17           | 0        | 6/14          | 24                          | 0        | 6/12          | 30      | 0/6      | 6/22          | ..      | ..       | ..            | Case 1 : 5 weeks |          |               |
| 6                                 | 18           | 0        | 2/8           | 33                          | 0/10     | 4/28          | 46      | 0/2      | 4/18          | ..      | ..       | ..            | 45               | 0        | 6/10          |
| 7                                 | 10           | 0        | 4/10          | 14                          | 9        | 4/10          | 25      | 0        | 6/10          | ..      | ..       | ..            | ..               | ..       | ..            |
| <i>Hypochlorhydria : 10 cases</i> |              |          |               |                             |          |               |         |          |               |         |          |               |                  |          |               |
| 8                                 | 25           | 0/2      | 2/12          | 32                          | 0        | 4/10          | 42      | 0/8      | 4/32          | 45      | 2/12     | 4/28          | 52               | 0/4      | 4/10          |
| 9                                 | 10           | 2/12     | 14/28         | 11                          | 0/16     | 4/44          | 16      | 0/20     | 4/38          | 27      | 4/36     | 6/48          | 29               | 0/20     | 4/36          |
| 10                                | 20           | 0/8      | 2/16          | 20                          | 0/12     | 4/20          | 25      | 6/16     | 8/28          | 28      | 6/30     | 8/40          | 34               | 2/6      | 8/16          |
| 11                                | 19           | 0/6      | 2/14          | 22                          | 0/8      | 2/16          | 22      | 0/4      | 6/20          | 36      | 2/18     | 4/28          | 44               | 2/40     | 4/52          |
| 12                                | 13           | 0/22     | 10/34         | 17                          | 2/46     | 10/56         | 35      | 8/46     | 10/54         | 44      | 2/28     | 12/40         | 44               | 4/32     | 8/42          |
| 13                                | 13           | 0/2      | 8/22          | 14                          | 0        | 4/8           | 26      | 0/4      | 6/12          | 30      | 0/8      | 4/14          | ..               | ..       | ..            |
| 14                                | 20           | 0/12     | 4/24          | 21                          | 0/16     | 4/30          | 24      | 0/8      | 8/16          | 25      | 0/18     | 6/20          | Case 9 : 5 weeks |          |               |
| 15                                | 18           | 0/24     | 6/36          | 27                          | 0/66     | 6/72          | 40      | 0/66     | 6/72          | ..      | ..       | ..            | 42               | 0/22     | 8/34          |
| 16                                | 12           | 0/14     | 6/22          | 18                          | 0/12     | 4/14          | 33      | 0/24     | 4/28          | 40      | 0/10     | 2/18          | ..               | ..       | ..            |
| 17                                | 10           | 0/8      | 6/26          | 16                          | 4/10     | 6/26          | 28      | 2/10     | 8/16          | 40      | 2/14     | 6/32          | ..               | ..       | ..            |

It was not determined whether the achlorhydrias are histamine refractory as this question is unimportant from the point of view of this investigation.

For the graphical presentation of the variations of the gastric function under anti-anæmic treatment with reference to the simultaneous blood condition, the investigated cases have been placed in three groups: achlorhydria (7 cases), hypochlorhydria (10 cases) and normo- plus hyperchlorhydria (20 cases). The curves are condensed from the test meal results of all the cases belonging to the same group; thus figure 1 (a) was traced by calculating the mean value of

acidity of the resting juice and of all the following samples, respectively, recovered during the fractional test meal on admission from the seven achlorhydric cases. Similarly figure 1 (b), (c), (d) and (e) are condensed from the fractional test meal curves of the same seven cases, after one, two, three and four weeks of anti-anæmic treatment. The broken horizontal line in each of these figures marks the hæmoglobin percentage average value of the same cases at the same stage of treatment at which the fractional test meal was examined.

Correspondingly, figure 2 (a) to (e) represent the condensed curves of free HCl and total

TABLE II.

Hæmoglobin per cent, free HCl and total acidity before and during anti-anæmic treatment: weekly variation of mean values, calculated for every group of acidity

| Acidity group                  |                  | On admission | DURATION OF ANTI-ANÆMIC TREATMENT |         |         |         |
|--------------------------------|------------------|--------------|-----------------------------------|---------|---------|---------|
|                                |                  |              | 1 week                            | 2 weeks | 3 weeks | 4 weeks |
| Achlorhydria ..                | Hb. per cent ..  | 14           | 17                                | 24      | 31      | 39      |
|                                | Free HCl ..      | 0            | 3                                 | 1       | 4       | 2       |
|                                | Total acidity .. | 7            | 11                                | 8       | 10      | 10      |
| Hypochlorhydria ..             | Hb. per cent ..  | 16.1         | 19.8                              | 29.1    | 35      | 40.6    |
|                                | Free HCl ..      | 5            | 9                                 | 9       | 7       | 6       |
|                                | Total acidity .. | 15           | 17                                | 17      | 15      | 15      |
| Normo- and hyperchlorhydria .. | Hb. per cent ..  | 13.2         | 19.7                              | 26.3    | 30.4    | 33.75   |
|                                | Free HCl ..      | 25           | 23                                | 21      | 20      | 24      |
|                                | Total acidity .. | 36           | 36                                | 29      | 28      | 33      |

Fig. 1.—Achlorhydric group.

Graphs condensed from all the test-meal curves during anti-anæmic treatment of

7 cases      7 cases      7 cases      4 cases      4 cases  
On admission    One week    Two weeks    Three weeks    Four weeks  
a                    b                    c                    d                    e

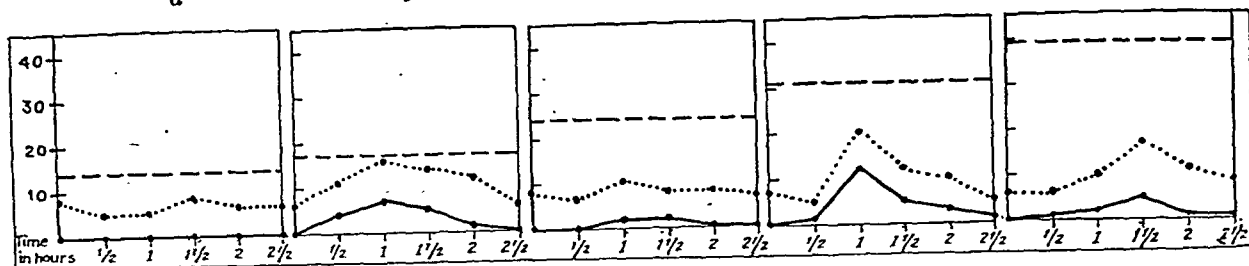


Fig. 2.—Hypochlorhydric group.

Graphs condensed from all the test-meal curves during anti-anæmic treatment of

10 cases      10 cases      10 cases      9 cases      5 cases  
On admission    One week    Two weeks    Three weeks    Four weeks  
a                    b                    c                    d                    e

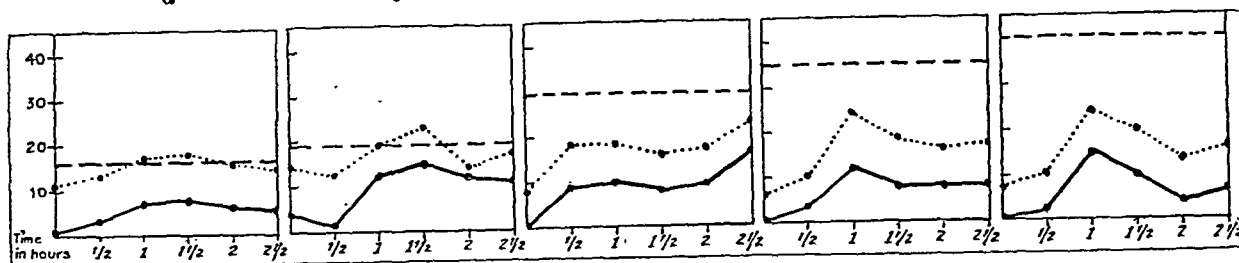


Fig. 3.—Normo- + hyperchlorhydric group.

Graphs condensed from all the test-meal curves during anti-anæmic treatment of

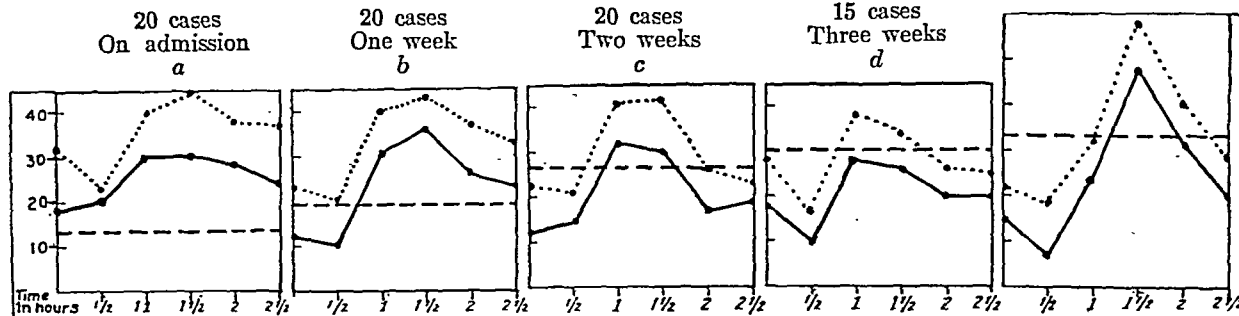
20 cases  
On admission  
a

20 cases  
One week  
b

20 cases  
Two weeks  
c

15 cases  
Three weeks  
d

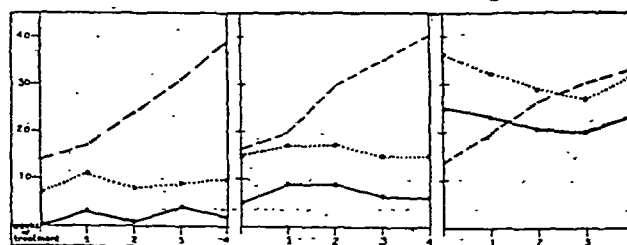
10 cases  
Four weeks  
e



Free HCl —————  
Total acidity .....  
Haemoglobin % ————

acidity of the ten hypochlorhydric cases on admission and after one to four weeks of anti-anæmic treatment respectively; figure 3 (a) to (e) show the variations, week by week, in the normo- plus hyperchlorhydric group of 20 cases.

The figures in table I and the comparison of the charts belonging to one and the same group make it equally probable that the gastric function is independent of the improved blood condition. To make this point quite clear, we condensed the five charts of each group, which represents the mean values of the weekly fractional test meal, to one main curve for each of the three groups in the following way: from each of the 'week-curves' the mean value of the free and total acidity, respectively, was calculated; in such a manner we got one value for the free and one for the total acidity (for each of the three groups) on admission, one for each of them after one, two, three and four weeks

Fig. 4.—Achlorhydria.  
Condensed from fig. 1 a-e.Fig. 5.—Hypochlorhydria.  
Condensed from fig. 2 a-e.Fig. 6.—Normo- + hyperchlorhydria.  
Condensed from fig. 3 a-e.

Free HCl —————  
Total acidity .....  
Haemoglobin % ————

of anti-anæmic treatment; the mean haemoglobin values on admission and at the end of every week of treatment constitute the third curve (broken line) in the figures 4, 5, 6 which

permit an immediate comparison and evaluation of the correlation between blood condition and gastric acidity. The figures resulting for each group in this way of condensation are given in table II.

In the achlorhydric group, after four weeks of iron medication, the free HCl increases from 0 to 2, the total acidity from 6 to 10, whereas the hæmoglobin rises steeply from 14 to 39 per cent in the average of seven cases.

Anti-anæmic treatment of the same duration in the ten hypochlorhydric cases increased free HCl from 5 to 6, the total acidity remained constant at 15, the hæmoglobin content rose from 16 to 40.6 per cent.

The last group, which contains 20 normo- or hyperchlorhydric cases, shows under equal conditions of treatment, free HCl almost unchanged, varying only from 25 to 24, total acidity from 36 to 32; the hæmoglobin increased from 13 to 33.7 per cent.

### Discussion

Before an evaluation of these results may be attempted, the distribution of the different groups of acidity among hookworm anæmias found in previous investigations,\* has to be compared with that in our cases. Table III serves this purpose.

investigation cases separately, the normo-chlorhydrias are the strongest group (30 per cent), closely followed by hypochlorhydrias (27 per cent), at a greater distance by hyperchlorhydrias (24 per cent), and finally by the group of achlorhydrias (19 per cent). Our figures in the investigation group seem to be quite reliable (for Mysore) as they have been confirmed by all the following weekly examinations.

Napier and Das Gupta (1935-36) compared their Assam figures with those of 'normal' Indians from Bengal; they found almost the same mean HCl curve in women suffering from hookworm anæmia and in 'normal' females; the figures have been slightly lower for anæmic than for 'normal' men.

Due to the kindness of Dr. C. Srikantia, professor of chemistry, Messrs. S. Hiraniya, professor of physiology and L. Kantiengar, lecturer in chemistry, University Medical College, Mysore, we are able to compare the ratio of the various levels of acidity in hookworm anæmia in Mysore with that among 91 normal healthy Mysoreans (college students). In a personal communication these authors permitted us to use their figures. For easier comparison we put the results obtained in normal test subjects side by side with those of our hookworm

TABLE III

*Comparison between the gastric acidity in hypochromic hookworm anæmia in different places.*

| Place                 | Total number of cases | Per cent achlorhydric | Per cent hypochlorhydric | Per cent normo-chlorhydric | Per cent hyperchlorhydric | Authors                               |
|-----------------------|-----------------------|-----------------------|--------------------------|----------------------------|---------------------------|---------------------------------------|
| Assam ..              | 31                    | 6                     | 16                       | 68*                        | 10                        | Napier and Das Gupta, 1935-37.        |
| Calcutta ..           | 28                    | 11                    | 15                       | 28<br>(57)†                | 46                        | Napier, Das Gupta and Majumdar, 1941. |
| Mysore ..             | 51                    | 22                    | 28                       | 25                         | 25                        | } Present investigation.              |
| Mysore special cases. | 37                    | 19                    | 27                       | 30                         | 24                        |                                       |

\* A wider range of normality adopted. † Figure of same range of normality as above is adopted.

Taking for a detailed comparison only the recent figures from Calcutta, one finds great differences between them and our results; whereas the hypofunction group (below 25 free HCl) of Napier *et al.* (1941) contains 26 per cent of the examined 28 cases, our corresponding group comprises 50 per cent of all examined and 46 per cent of the followed-up 37 cases; thus, in Calcutta the normo-hyperchlorhydric cases (74 per cent) are by far predominant, whereas in Mysore the border line of 25 free HCl divides into equal halves those below and those above it among 51 hookworm anæmias; taking the

anæmias. Though a difference between the gastric acidity of men and women is definite in the results of Srikantia, Hiraniya and Kantiengar (main free HCl in men only: 35.5, men + women : 32.1), we compare their total results with ours, for the reasons mentioned before.

The differences are striking; whereas the group between free HCl 20 and 49 contains 66.5 per cent of normal Mysoreans, it includes only 40 per cent of hookworm anæmias. Correspondingly only 22 per cent of the normal test subjects show free HCl below 20, but 42 per cent of hookworm anæmias are to be found in this group; still greater is the difference in the lowest range of acidity; 4.3 per cent of normal persons against 28 per cent of hookworm anæmias have free HCl values below 9. The normal figures of Srikantia

\* The figures of McRobert *et al.* (1940) cannot be used for comparison because these authors include all kinds of anæmias in their 100 cases and remark regarding hookworm anæmias only, that among 77 cases 27 = 35 per cent have been achlorhydric.

TABLE IV

Comparison between the gastric acidity of 91 healthy college students and 51 hookworm anæmias in Mysore.

| Free HCl | NORMAL |          | HOOKWORM ANÆMIA |          |
|----------|--------|----------|-----------------|----------|
|          | Cases  | Per cent | Cases           | Per cent |
| 0-9      | 4      | 4.3      | 14              | 28       |
| 10-19    | 16     | 17.6     | 7               | 14       |
| 20-29    | 28     | 30.8     | 6               | 12       |
| 30-39    | 13     | 14.3     | 5               | 10       |
| 40-49    | 18     | 20       | 9               | 18       |
| 50-59    | 10     | 11       | 5               | 9        |
| > 60     | 2      | 2        | 5               | 9        |

*et al.* show more similarity with those found by Napier *et al.* (1941) among hookworm anæmia in Calcutta, than with our own results. However, the comparison of these two local groups proves that in hookworm anæmia a far higher percentage of low acidity is to be found than among the healthy population.\*

Whether it is the anæmia or the hookworm infestation which is responsible for the gastric underfunction in a percentage twice as high as among normal persons is under investigation. But what can be stated definitely at present is that the improvement of the blood condition has practically no influence on the stomach function; the quantity of free HCl which appears in the achlorhydric and the increase of free HCl in the hypochlorhydric cases after four to five weeks of highly successful anti-anæmic treatment is so small that it does not change the efficiency of gastric function at all; equally the variations in the normo- *plus* hyperchlorhydric group are of no real importance for the digestive power. Similar facts are known regarding pernicious anæmia and 'idiopathic hypochromic anæmia'; the changes in the gastric function are irreversible in both these conditions, just as in hookworm anæmia (without deworming).

Another fact which becomes evident from our results is the independence of blood condition and blood improvement in hookworm anæmia from the gastric acidity. The average value of hæmoglobin on admission was the lowest in the normo- *plus* hyperacidity group (figure 3), 13.2 per cent against 16 per cent in the hypochlorhydric and 14 per cent in the achlorhydric patients. These differences might be accidental, except that the mean value of hæmoglobin reached after four weeks of iron medication was again the lowest in the normo- *plus* hyperchlorhydric group (33.7 per cent against 40.6 per cent and 39 per cent, respectively) proves beyond doubt that neither the

free HCl production nor the pH of the gastric juice are deciding factors for the utilization of inorganic iron; in fact the absolute increase of the hæmoglobin level in the average of the three groups was the highest in the achlorhydric group, namely 25 per cent, about the same—24.6 per cent in the hypochlorhydric, and only 20.5 per cent in the normo- *plus* hyperchlorhydric hookworm anæmias; consequently more patients in the last group needed longer anti-anæmic treatment than the usual three to four weeks in preparation for deworming than in both the other groups.

### Conclusion

Among 51 hookworm anæmias in Mysore the percentage of those with a gastric acidity below 20 free HCl is twice as high (42 per cent) as among 91 healthy normal Mysoreans (22 per cent).

The blood condition of 37 hookworm anæmias was greatly improved by iron medication without deworming; the simultaneous variations in the gastric function have been negligible; none of the groups—achlor-, hypo-, normo-, nor hyperchlorhydrias showed any definite change of the acidity values before and after anti-anæmic treatment.

The improvement of the blood condition proceeded independent of the gastric acidity; it was achieved more quickly and more extensively in achlorhydric than in normo- *plus* hyperchlorhydric patients.

### Summary

The gastric acidity of 51 patients suffering from hookworm anæmia was estimated. Their gastric function was compared with that of normal Mysoreans.

Thirty-seven of these patients have been investigated before and during anti-anæmic treatment; erythrocyte count, hæmoglobin content and fractional test meal have been examined at weekly intervals. The results are reported.

The influence of blood improvement on gastric acidity is presented in curves and tables.

The influence of gastric function on blood condition, blood improvement and iron utilization is discussed.

Our thanks are due to Dr. C. Srikantia, Messrs. S. Hiraniya and L. Kantiengar for their kind permission to use their results, personally communicated to us, before their own publication.

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*Indian Med. Gaz.*, **73**, 65.

\* Whether a difference in the diet among these two groups plays a major part in bringing about the differences was not investigated by us; however, all of them were rice-eaters (*cf.* Napier *et al.*, 1938).

## REPORT OF A CASE AND AN ANALYSIS OF TWENTY-TWO CASES OF BRONCHO- GENIC CARCINOMATA\*

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THE following case came to the out-door department of Sir J. J. Hospital and was subsequently under my care in the wards of the hospital. It was diagnosed tentatively as 'sarcoma of the scalp', but at the *post-mortem* examination it was discovered to be a secondary deposit from a carcinoma of the left bronchus.

A Hindu male, aged 35 years, reported at the out-door department of Sir J. J. Hospital, complaining of a swelling on the back of his head. He stated that five months ago, *i.e.*, in January 1938, he noticed a small nodular swelling in the occipital region. At that time it was painless and so he did not pay any attention to it, but during the two following months the nodule had grown in size and had become slightly painful. He therefore went to a hakim and had the tumour cut by him—some time in February 1938. As a result of this treatment, the nodule instead of subsiding began to grow with greater vigour, until it had attained its present size. During these past three months, while it had been growing in size, it had become ulcerated in places and painful, and had begun to discharge what the patient described as pus and serum. The patient had been suffering from cough and fever for the last one month only.

*Examination.*—There is a large swelling on the back of the head occupying the whole of the occipital and part of the parietal regions on both sides (figure 1). Approximately, the size of the tumour is 8 inches by 8 inches and it is raised for about 4 inches above the surface of the head. The surface of the tumour is nodular over its greater extent and in this area the growth is raw-looking and ulcerated in places. The ulcerated surface is discharging pus and seropurulent material, and blood is seen to ooze out of a few of the ulcerated spots. In some places the area shows adherent sloughs. On more detailed examination each nodule appears to be studded on its exposed surface with coarse large granulations. The remaining part of the growth is covered with scalp which is normal in some places and undermined in others. In this region a few dilated veins can be seen.

On palpation, the feel of the growth varies in different parts. In some places, it is firm while in the area immediately surrounding the raw-looking nodular surface it is fluctuating, especially in both the parietal regions. The ulcerated and raw-looking surface is friable. The whole growth has a superficial mobility and gives the impression that it is adherent to the underlying bone. There are no palpable lymph nodes.

\* A part of this paper was read before a meeting of the 'Teaching Pathologists', Bombay.

(Continued from previous page)

NAPIER, L. E., and DAS *Indian J. Med. Res.*, **23**,  
GUPTA, C. R. (1935-36), 305, 311, 455 and 973.

*Idem* (1935-37) *Ibid.*, **22**, 809; **23**, 305, 311,  
455 and 973; **24**, 85 and 1159.

NAPIER, L. E., DAS *Indian Med. Gaz.*, **76**, 1.  
GUPTA, C. R., and  
MAJUMDAR, D. N. (1941).

*Clinical examination of the lungs.*—No impaired note on percussion, no bronchial breathing, but râles and rhonchi are present as adventitious sounds. Liver and spleen are not enlarged. The general condition of the patient is emaciated and toxic-looking. The patient was admitted for further investigation.

*Clinical diagnosis.*—Fungating sarcoma of the scalp. Under local anaesthesia a biopsy was performed. There was smart bleeding from the cut edge of the tumour which was checked by diathermy coagulation and firm pressure. *Report of tissue examination.*—'Loose texture, abundant lymph spaces, few epithelial

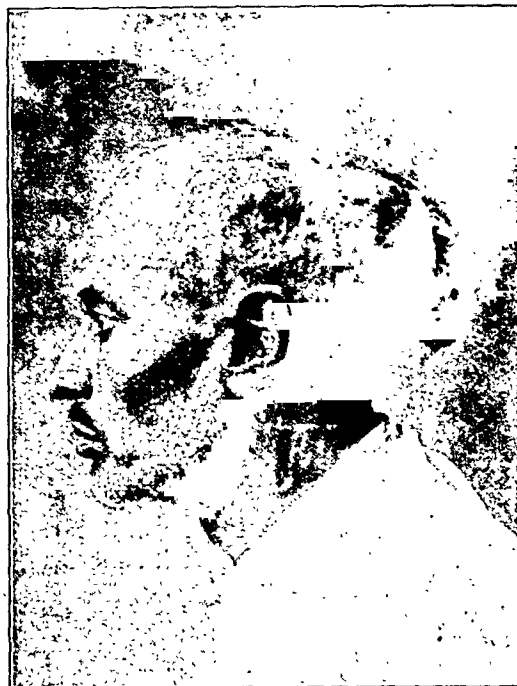


Fig. 1.

pearls. The greater bulk is connective tissue malignant tumour'.

Other investigations:—

Wassermann reaction—Negative.

Urine examination—

Albumin present.

Bence-Jones proteins absent.

Pus cells and red cells present.

Blood examination—

Red cells .. .. 2,400,000 per c.mm.

Leucocytes .. .. 6,000 " "

Differential count—

Polymorphonuclears . . . 76 per cent.

Lymphocytes .. .. 18 " "

Eosinophils .. .. 3 " "

X-ray photographs—

(a) Skull—'Malignant tumour eroding posterior part of skull' (figure 2).

(b) Lungs—'Secondaries ribs and lungs'.

From the time of his admission, his general condition gradually grew worse every day, and in view of his general condition and the x-ray findings it was decided that the neoplasm had advanced too far to institute any curative or even palliative line of treatment. His pain and other discomforts were relieved with morphia. The patient died on 20th June, 1938.

*Post-mortem report.*—The body is that of a male aged about 45 years, considerably emaciated. There is a growth in the occipital region

about the size of an orange, ulcerated on the surface, nodular, and having a raw appearance. On opening the skull the growth is seen to have destroyed a greater part of the occipital bone below the occipital prominence, and to have pressed inwards the dura underlying this part.

*Right lung*—shows a few sub-pleural cellular nodules. Compensatory emphysema is seen at the margins of both lungs, but more prominent in the right lung.

*Left lung*—shows two abscess cavities one below the other at the apical region. The walls of the cavities are irregular and the contents muco-purulent. Near the hilum one of the bronchi shows infiltration, blocking its lumen.

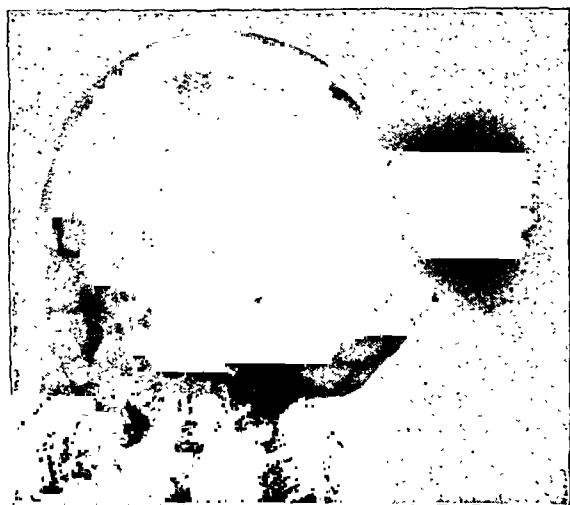


Fig. 2.

*Liver*—shows a large growth at the right lobe, the size of a cricket ball. The growth is cellular with yellowish streaking along its surface. Two other small nodules are seen in the lower portion.

*Left kidney*—shows an irregular cellular growth on its convex margin about the middle, snow white in colour.

*Right suprarenal*—shows a nodule at its apex.

*Stomach*.—Normal.

*Spleen*.—Not enlarged, capsule thickened at places, and shows a calcified plaque in the capsule.

*Other organs*.—Normal.

#### *Histological report of sections from post-mortem tissues*

*Three sections of lungs*.—Two sections of the wall of the suspected tuberculous cavities show exuberant granulation tissue. No tumour cells detected. There is an exuberant growth of epithelioid tissue as well as tuberculous broncho-pneumonia, with areas of caseation.

The third section shows sheets of large round or oval cells, irregular in shape, as well as narrower strands of the same situated more proximally, while there is an adenomatous proliferation of the same cells more distally. No evidence of tubercle.

*On section of lymph gland* (mediastinal, with bronchial cartilage and mucous glands).—One gland shows caseating tubercle while another shows marked congestion and hæmorrhage and partial disorganization of the architecture. No metastatic deposits.

*One section of liver*.—It shows secondary deposits: irregular sheets and strands. The pattern of the proliferation is not adenomatous.

*One section of suprarenal*.—More of adenomatous proliferation, less of irregular strands and sheets.

#### *Earlier cases*

A detailed study of the above case prompted me to look into the past records of the pathology department, Sir J. J. Hospital, of cases of tumours, particularly bronchogenic carcinomata, arising primarily in the thoracic cavity. By this is meant to include only those tumours which arise from the intra-thoracic respiratory organs and other tissues, excluding however the œsophagus, cardiac end of the stomach, heart and the pericardium.

The total number of cases is thirty, from the year 1886 to December 1938. Prior to 1886 there is a record of only one case mentioned in the catalogue of 1879 which runs as follows: 'Scirrhus tumour surrounding the lower end of the trachea and the commencement of the bronchi. The patient suffered from urgent dyspnoea and died of asphyxia'.

Histological sections cannot be traced of any of the cases that occurred between 1886 to 1908, nor is the material available for making fresh microscopic preparations. The information about these cases which number eleven is therefore obtained from recorded notes only. From 1908 to 1925 no case of intra-thoracic tumour is found in the *post-mortem* records of this period.

Out of the thirty cases, twenty-two are carcinomata, six are sarcomata, one is a hæmangioma of the pleura, and one gumma. For purposes of analysis all cases other than those of carcinoma are omitted, and the twenty-two cases of carcinoma which are analysed have apparently all arisen primarily from intra-thoracic portion of the respiratory tract—bronchogenic carcinomata.

It is fully realized that the number of cases is too small to draw any far-reaching conclusions; also in addition the recording of some of the cases is very incomplete. The total number of thirty cases is divided into the following three chronological groups:—

|                           | Number of cases | Carcinomata |
|---------------------------|-----------------|-------------|
| 1. From 1886 to 1908 ..   | 12              | 9           |
| 2. From 1926 to 1937 ..   | 14              | 10          |
| 3. From Jan. to Dec. 1938 | 4               | 3           |
|                           | —               | —           |
| TOTAL ..                  | 30              | 22          |



## Group I. 1886 to 1908

|     | Date       | Sex | Age | Clinical history  | Right lung                                     | Left lung   | Liver                        | Kidney                | Bone or brain                               | Glands  |
|-----|------------|-----|-----|---|--|---|------------------------------|-----------------------|---|---|
| (1) | 11-9-1886  | M.  | 48  | Cough, pain in the abdomen, right lumbar and iliac regions. Attacks of hæmoptysis occasionally 2 months ago. Enlarged liver and swelling of ribs. | Lower half broken down and upper consolidated. | Infiltrated with growth.  | Several large tumour masses. | ..                    | ..  | Lumbar; growth in small intestine near ileocolic valve. |
| (2) | 20-2-1887  | M.  | 30  | Sudden loss of power of right side.   | Multiple nodules.                              | Multiple nodules.   | ..                           | Multiple nodules.     | Multiple nodules in brain.                  | ..  |
| (3) | 29-4-1892  | M.  | 35  | Painful swelling of the neck for five months and troublesome cough.   | Two nodules.                                   | ..  | ..                           | ..                    | ..  | Bronchial.  |
| (4) | 1-2-1898   | M.  | 30  | Clinical history not available.   | ..   | Solid. Covered with pleurisy. Infiltrating nodules in base. Left bronchus stenosed. | Several nodules.             | ..                    | ..  | Posterior mediastinal.                                  |
| (5) | 31-3-1901  | M.  | 50  | Complaint of hæmoptysis.  | Growth   | Growth  | ..                           | Growth one kidney.    | ..  | Gland in neck.  |
| (6) | 8-4-1905   | M.  | 50  | Fever, cough, pain behind the sternum and hepatic region. Sudden attack of paralysis.   | Base   | ..  | ..                           | ..                    | Left hemisphere just above Sylvian fissure. | At bifurcation of trachea and mesenteric.               |
| (7) | 28-6-1905  | M.  | 40  | Clinical history not available.   | ..   | Bronchus  | Nodule                       | Nodule in one kidney. | Spine and skull.                            | ..  |
| (8) | 17-7-1908  | M.  | 30  | Clinical history not available.   | Apex   | ..  | ..                           | ..                    | ..  | Posterior mediastinal.                                  |
| (9) | 13-11-1908 | M.  | 30  | Cough and fever, pain and dullness in the chest.  | Root of lung.                                  | ..  | ..                           | ..                    | ..  | ..  |

## Group II. 1926 to 1937

|     |           |    |    |  |   |   |        |                          |                        |                    |
|-----|-----------|----|----|--|---|---|--------|--------------------------|------------------------|--------------------|
| (1) | 12-2-1926 | M. | 30 | Ill for 3 years. Pain left lumbar region for 1 year. Lump in left kidney region. Pain in chest 3 years. Sinus in region of left 4th rib. Dullness on left side of chest. Clinical diagnosis of primary lung tumour and secondary in the left kidney. | Right pleural sac.  | Left pleural sac and pericardium, bronchus. | Nodule | Nodules in both kidneys. | ..                     | Pelvic peritoneum. |
| (2) | 20-6-1927 | M. | 37 | Gradual dysphagia for 2 months. Hoarseness of voice, fœtid breath and sputum. No physical signs of aneurysm. X-ray shows shadow pressing on the œsophagus.   | A lump between the œsophagus and trachea and at the bifurcation of the trachea. | ..  | ..     | ..                       | ..                     | ..                 |
| (3) | 6-10-1930 | M. | 50 | Cough with muco-purulent expectoration. Loss of power of right half of the face.   | Right lung  | ..  | ..     | ..                       | Surface of cerebellum. | ..                 |

*Group II. 1926 to 1937—concl.*

|      | Date       | Sex | Age | Clinical history   | Right lung   | Left lung                          | Liver             | Kidney | Bone or brain                           | Glands                           |
|------|------------|-----|-----|--|--|------------------------------------|-------------------|--------|---|----------------------------------|
| (4)  | 29-12-1933 | M.  | 50  | Frequency of stools for 3 months. No blood or mucus. Pain in right hip; sprain 3 months ago. Marked wasting of gluteal muscles. Hip movements possible but painful. Thickening of ileum and greater trochanter. Clinical diagnosis Ewing's tumour. | New growth in bronchus extending from hilum into the right lung. | ..                                 | ..                | ..     | Ribs, vertebrae, skull and iliac bones. | ..                               |
| (5)  | 24-1-1934  | M.  | 35  | Multiple sinuses in both groins. Difficulty in micturition. Prepuce and glans penis sloughed off.  | ..   | Lung and bronchus. Bronchiectasis. | ..                | ..     | ..                                      | Glands both sides.               |
| (6)  | 20-3-1935  | M.  | 60  | Severe pain in chest for 3 months.   | Hilum tubercle infection.  | ..                                 | ..                | ..     | Brain and meninges.                     | ..                               |
| (7)  | 28-9-1935  | M.  | 45  | Clinical history not available.  | Nodule in bronchus.  | ..                                 | Many nodules.     | ..     | ..                                      | Bronchial lymph glands.          |
| (8)  | 12-6-1936  | M.  | 18  | Frequent stools 3 months. Macular syphilis 3 months.   | ..   | Soft fleshy lump.                  | ..                | ..     | ..                                      | ..                               |
| (9)  | 21-4-1937  | M.  | 45  | Unconscious with convulsions. Right sided hemiplegia, no conjunctival reflex, pupils react sluggishly.   | Bronchus   | Bronchus                           | Multiple nodules. | ..     | Skull and brain.                        | Large lump on left side of neck. |
| (10) | 29-6-1937  | M.  | 48  | Pain all over for 2 months. Tubular breathing left side; interspaces sunken, clubbing of fingers.  | ..   | Near the base.                     | ..                | ..     | ..                                      | ..                               |

*Group III. 1938*

|     |           |    |    |  |  |  |             |                            |       |                                       |
|-----|-----------|----|----|--|--|--|-------------|----------------------------|-------|---------------------------------------|
| (1) | 23-4-1938 | M. | 45 | Irregular fever 1 month. Cough. Pain in the chest when coughing. Diminished movements left side. Blood stained sputum. Vocal resonance diminished. | ..   | Infiltrated, also bronchus.              | Nodule      | Nodule in left kidney.     | Brain | Glands near the head of the pancreas. |
| (2) | 20-6-1938 | M. | 35 | Cough with expectoration. Pain in chest both sides. Low fever for 5 months. Cough is unceasing.  | Bronchus and pleura and tuberculous infection. | ..                                       | ..          | ..                         | Brain | Bronchial glands.                     |
| (3) | 31-6-1938 | M. | 35 | Fungating growth scalp, occipital region. Cough and fever 1 month. Clinical diagnosis—sarcoma scalp. X-ray—eroded skull and secondaries in lungs.  | ..   | Left bronchus and tuberculous infection. | Large mass. | Nodule and in supra-renal. | Skull | Bronchial glands.                     |

*Analysis*

1. All the twenty-two cases occurred in males.

2. Clinical history is available in eighteen cases out of which thirteen cases, i.e., about 72 per cent, manifested signs or symptoms or both

which could be definitely referred to an intrathoracic disease; and out of these again 66.6 per cent complained of cough.

3. As regards the age incidence, 50 per cent of cases in this series occurred between the ages of 30 to 40 years and 40.9 per cent between the

ages of 40 to 50 years. In the series published by Brines and Kenning (1937) only 14.8 per cent occurred between the ages of 30 to 40 years and 26.4 per cent between the ages of 40 to 50 years. In the series published by Frissell and Knox (1937), only 10.8 per cent and 13 per cent occurred between the ages of 30 to 40 years and 40 to 50 years respectively. On taking the age period of 30 to 50 years in the writer's series 91 per cent of cases occurred in this age period.

4. In this series the right side appears to be more commonly affected than the left—54.5 per cent and 45.5 per cent. In statistics of 3,735 cases published by Fischer, 53 per cent occurred on the right side and 45 per cent on the left side.

5. As regards metastases in this series 77.2 per cent of cases had secondary deposits in one or more parts of the body. In the series published by Fischer, 80 per cent of cases had secondary deposits.

6. Of all the places in the body as sites of secondary deposits, the liver is found to be the commonest—36.3 per cent of cases, the next common site being the brain 31.8 per cent; and out of those cases which had secondary deposits in the brain more than 50 per cent exhibited signs referable to central nervous lesion.

7. Bones in themselves do not appear to be common as sites of secondary deposits, but out of all the bones, skull bones are those which are most commonly affected—in every case in this series whenever there were secondary deposits in the bones.

8. Association of tuberculous infection is found to be present in three cases.

#### *Pathological and histological comments*

Of the twelve cases—of intra-thoracic tumours—recorded from 1886 to 1908, three are sarcomata and the remaining nine are bronchogenic carcinomata, as judged from the study of recorded notes. One of these nine cases is histologically diagnosed as 'alveolar sarcoma'.

Of the eighteen cases recorded from 1926 to 1938, five are non-epithelial in origin: one a cavernous hæmangioma of the pleura, another a lympho-sarcoma of the mediastinal glands, two others are spindle-celled sarcomata of the lung, and one a sarcoma of the ribs. The remaining thirteen are carcinomata of the lungs, eleven hilar, one apical and one peripheral—all bronchogenic in origin, except the last which has a texture of an adenocarcinoma of the lung parenchyma. Of the eleven hilar, two are columnar-celled adenocarcinomata, one a columnar-celled carcinoma, one a mixed spheroidal and columnar-celled type with few areas of adenomatous texture; three are stratified squamous epithelial in type, and about the remaining two the cell type cannot be clearly determined. The apical one is a spheroidal cell carcinoma and the peripheral one an adeno-carcinoma. The associated tumour of the penis in one of these cases is a squamous-celled

carcinoma with secondary deposits in the inguinal glands on both sides.

Metastatic deposits recorded in the nine cases are seen to have bred true in all but one case—the one which was sent to the pathologist as a biopsy piece with a clinical diagnosis of a primary sarcoma of the scalp—the case described in detail at the beginning of this paper. This showed extreme differentiation, exhibiting the morphology of a rapidly-growing connective tissue spindle-celled mass with stray epithelial pearls. The growth later turned out to be a secondary deposit from a spheroidal and columnar-celled bronchogenic carcinoma with adenomatous proliferation in places. The epithelial pearls were apparently of local origin.

The association of tuberculous infection in three of these cases is verified.

Donald Owen, T. H. Hewer and P. H. Whitker draw attention to a statement made by Geschicter and Denison that bronchogenic carcinomata can be rigidly divided into two classes: (1) those arising at the hilum which are squamous, basal-cell or oat-cell in type; and (2) those arising at the periphery of the lung which are adeno-columnar, adeno-mucoid, or adeno-cubical. Their study of twenty cases of hilar carcinomata does not warrant such a clear-cut finding. The analysis of the above thirteen cases lends support to their contention.

*Analysis in percentages.*—Total number of cases 22.

|  | Per cent. |
|--|-----------|
| 1. Right side involvement in 12 cases              | .. 54.5   |
| 2. Left side involvement in 10 cases               | .. 45.5   |
| 3. Both sides involved in 4 cases                  | .. 18.1   |
| 4. Secondary deposits in the liver in 8 cases      | 36.3      |
| 5. Secondary deposits in the brain in 7 cases      | 31.8      |
| 6. Secondary deposits in the kidney in 6 cases     | 27.2      |
| 7. Secondary deposits in the bones in 4 cases      | 18.1      |
| 8. Secondary deposits in the pleura in 1 case      | 4.5       |
| 9. Secondary deposits in the peritoneum in 1 case  | 4.5       |
| 10. Secondary deposits in the intestines in 1 case | .. 4.5    |

It is noteworthy that regarding secondary deposits in the bones, skull bones are involved in all the four cases, in some cases in addition to other bones.

#### *Conclusions*

1. The disease occurs in males.
2. The highest age incidence is between 30 to 50 years.
3. A large number of cases manifest signs or symptoms referable to an intra-thoracic lesion of which cough is the most prominent symptom.
4. A very large number of cases give rise to secondary deposits of which the commonest site is the liver, the next common site being the brain.
5. When secondary deposits occur in the bones, skull bones are the sites of choice.
6. The right side is slightly more commonly affected than the left.

(Concluded on opposite page)

# AN ANALYSIS OF 356 CASES OF ENTERIC FEVER TREATED IN THE KING EDWARD MEMORIAL HOSPITAL, SECUNDERABAD, DECCAN

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Deccan

THOUGH enteric fever is prevalent in Secunderabad every year and continues throughout the year, it broke out in an epidemic form about the end of August last year, and during its two months' virulence it carried away a good many young adults. The rush to the K. E. M. Hospital, Secunderabad, at that time was so great that a wing of the surgical section was utilized to accommodate the enteric cases.

The total number of cases treated was 356, out of which 284 were cured and 72 died, which included 19 cases admitted moribund and died within 24 hours and 6 cases within 72 hours.

## The method of examination

As a routine all patients admitted for fever are examined for malaria and blood taken for

(Continued from previous page)

## Summary

1. One case of bronchogenic carcinoma which had come under the writer's personal observation is described in detail.
2. All the records available in the pathology department of Sir J. J. Hospital of cases of bronchogenic carcinomata are reviewed.
3. The twenty-two cases are divided into three chronological groups.
4. All cases are analysed in a table and regarding some points a comparative view is given.
5. Conclusions arrived at from a study of these cases are given.

## Acknowledgments

I must thank Prof. P. V. Gharpure for giving me facilities and all the necessary help during the search of these records. I am indebted to Dr. J. L. Saldhana, assistant professor of pathology, who has entirely written the histological section of this paper. I have also to thank the radiologist and the hospital artist for supplying copies of the radiograms and photographs. I must also thank the Superintendent, Sir J. J. group of hospitals, for allowing me to publish the case records.

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culture and Widal test. In this series the result was as follows:—

|   |     |
|---|-----|
| Blood for malarial parasites negative in all cases  |     |
| Blood culture positive for enteric group of fevers  | 26  |
| Widal positive for <i>B. typhosus</i> (see table I)   | 218 |
| Widal positive for <i>B. paratyphosus</i> A   | 9   |
| Blood culture, repeated Widal and agglutination tests for <i>Proteus</i> X and <i>Brucella</i> group of organisms negative, but clinically enteric type | 83  |
| Not taken   | 20  |

TABLE I  
Widal reaction

| Titre ..                  | 1 : 125 | 1 : 250 | 1 : 500 | 1 : 5,000 | Total |
|---------------------------|---------|---------|---------|-----------|-------|
| <i>B. typhosus</i>        | 40      | 47      | 23      | 108       | 218   |
| <i>B. paratyphosus</i> A. | 2       | 1       | 1       | 5         | 9     |
| TOTAL ..                  |         |         |         |           | 227   |

## General management

Absolute rest in bed, position is changed at frequent intervals, regulation of diet and careful nursing to prevent complications. Symptoms are treated as they arise. The temperature and pulse are charted four hourly. If the temperature rises above 103.5°F. the patient is given cold sponging and ice applied to the head. The body is sponged once daily. Special attention is paid to the skin, the back and pressure points being treated with spirit and powder twice daily.

The diet aimed at in this hospital is one consisting of *not less* than 2,500 calories. The patient gets 3 pints of buffalo milk, one pint coffee, one pint tea, two ounces glucose, two ounces sugar, eight ounces soup and juice of two lemons. Patients are allowed to supplement their hospital diet with one ounce of honey, one ounce cream, juice of six oranges or sweet limes, eight ounces of buttermilk and plain milk chocolate. Paying ward patients get in addition cream-soup, Chivers jelly and custard. Between feeds patients are encouraged to drink plenty of water. Those who can afford it are given in addition pure vitamin C in tablet form and some proprietary preparations containing vitamins A, B and D in liquid form. Solid food is allowed after the temperature has been normal for ten days and five days later if everything goes on well the patient is discharged. The above-mentioned diet could not be given to serious cases and nasal feeding had to be resorted to.

## Treatment

Most of the patients were given a diaphoretic mixture. In a few cases septanilam was tried without beneficial result. Some patients were given oil of cinnamon only and it was noticed

that abdominal discomfort was very much less. To prevent cracked lips vaseline or boroglycerine was applied frequently. To prevent oral sepsis the mouth is cleaned with bicarbonate of soda and a slice of lemon fruit and the patients are encouraged to suck lemon fruits thrice daily and are given acid lemon drop sweets to suck. This keeps the salivary glands in working order. It has been found during the last three years that this line of treatment is very beneficial, very few cases of parotitis occurring. For meteorism oil of cinnamon by mouth and turpentine stupes were found very satisfactory. For constipation liquid paraffin and/or soap and water enema are given as required. For diarrhoea only when it is excessive, the patient is given kaolin and/or bismuth and salol and diet is reduced. When intestinal hæmorrhage occurs, the patient is given straight away morphia injection, the foot of the bed is raised, and ice is kept over the abdomen. Fluid and food are withheld for 24 hours. Calcium chloride or calcium gluconate is given intravenously. 500 mgm. of vitamin C is given intravenously daily for four days after the hæmorrhage has stopped and thereafter by mouth, since deficiency of this substance is believed to increase the fragility of the capillaries and to delay the healing of ulcers. Portnoy and Wilkinson found severe degrees of deficiency of vitamin C in hæmorrhage from peptic ulcer. Transfusion of blood is given when a donor is available.

For pneumonic cases M.&B. 693 is given. Retention of urine is treated first with hot fomentation over the bladder, and an enema. If this fails doryl is given by mouth. Catheterization is done only as a last resort. In toxic cases where there are signs of peripheral circulatory failure, 50 per cent glucose is given intravenously as required. Cardiazol, coramine or camphor in oil and strychnine injections are given as needed. Cortin (supra-renal cortical extract) was given in two cases and the result was encouraging. Saline by drip method per rectum was tried for toxic cases and the result was not encouraging.

### Complications

There was an unusually large number of cases with lung affections in this series and many cases with distension of the abdomen. There were 23 cases of intestinal hæmorrhage of whom 12 were cured and 11 died. There was one case of perforation and as the patient was in *extremis* operative treatment was refused by the relatives. One man aged 24 years, a month after his discharge from the hospital, while working in his office suddenly became unconscious and fell down with a hemiplegia of the left side. Speech was also affected. Blood pressure 120/80; Wassermann reaction was weak positive; urine was normal. He regained consciousness, power of speech and use of the affected limbs within a

(Concluded at foot of next column)

## FIVE-YEAR SALVAGE OF CARCINOMA CERVIX CASES TREATED BY RADICAL VAGINAL OPERATION

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THE rationale of the treatment of carcinoma cervix is still a controversial subject. While the general trend of opinion is going towards radiation therapy, the surgical treatment still occupies

(Continued from previous column)

week—perhaps a case of cerebral embolism (see table II).

TABLE II  
Complications

|                                      |            |                       |    |
|--------------------------------------|------------|-----------------------|----|
| Bronchitis ..                        | 53         | Otitis ..             | 6  |
| Pneumonia and broncho - pneumonia .. | 70         | Epistaxis ..          | 1  |
| Pleurisy ..                          | 5          | Hæmaturia ..          | 1  |
| Diarrhoea ..                         | 41         | Neuritis ..           | 8  |
| Distension ..                        | Many cases | Macular rash ..       | 4  |
| Hæmorrhage ..                        | 23         | Abortion ..           | 2  |
| Perforation ..                       | 1          | B. coli infection ..  | 1  |
| Parotitis ..                         | 10         | Multiple abscesses .. | 4  |
|                                      |            | Periosteal abscess .. | 1  |
|                                      |            | Cerebral embolism ..  | 1  |
|                                      |            | Relapse ..            | 31 |

Thirty-one cases relapsed. The relapse occurred on an average on the 11th day of normal temperature. The earliest was on the 5th day and latest on the 17th day. Secondary fever lasted on an average for 13 days. Five days was the shortest duration and 28 days was the longest. Two cases relapsed twice.

### Mortality

Three-hundred and fifty-six patients were admitted and 72 died giving a mortality rate of 20.22 per cent. If 19 patients who were admitted moribund and died within 24 hours are excluded, the mortality rate is 14.87 per cent only (see table III).

TABLE III  
Causes of death

|  |    |   |    |
|--|----|---|----|
| 1. Broncho-pneumonia ..                  | 8  | 5. Cardio-vascular failure ..                                 | 16 |
| 2. Pneumonia and hypostatic pneumonia .. | 7  | 6. Perforation ..   | 1  |
| 3. Toxæmia ..                            | 10 | 7. Admitted moribund. (Died within 24 hours after admission.) | 19 |
| 4. Hæmorrhage ..                         | 11 |   | 72 |

Six cases died within 72 hours of admission. These are included in cardio-vascular failure and toxæmia.

I am grateful to my chief, Colonel J. C. Pyper, O.B.E., I.M.S., for encouraging me to send this article for publication.

a great and well-established place in its management. Moreover, some workers who were previously converts of radiation therapy are coming back again to surgery supplemented by radiation therapy. So far as surgical procedure is concerned, the difficulty lies in proper and efficient technique of the operations, which are either Wertheim's radical abdominal operation, or Schauta's radical vaginal operation. Wertheim's operation is attended with enormous primary mortality, although satisfactory end-results have been found by Victor Bonny. Schauta's operation has been popularized and greatly improved by Adler by supplementing it with radiation therapy; but it is a difficult operation if conscientiously done. According to Stoeckel, most of the surgeons, while professing to perform the radical operation, are satisfied with a simple hysterectomy, thus bringing discredit to this particular method of treatment.

Before evaluating the end-results, I would like to give a few practical hints as regards the technique of the operation. The first point worth mentioning is that this operation is not a plain and simple vaginal hysterectomy; secondly, the uterus should be well dissected out to facilitate the removal of the greatest amount of parametrial tissue; thirdly, treatment of a carcinoma cervix case should not be considered complete unless and until the operation is supplemented by a thorough and intensive course of post-operative radiation. Here the difficulty is experienced by most gynaecologists, as they are either not quite conversant with the proper technique of the radiation therapy, or radium and deep x-ray apparatus are not available to them. It will be as bad as giving no treatment if only a partial or an incomplete radiation therapy is administered or if this treatment be deferred to an uncertain period by the x-ray department.

In a previous communique (Mitra, 1939) I gave a detailed technique of this operation with the immediate post-operative results and complications. It is now time to give a 5-year salvage of such cases. I shall try to put my results in tabular form. Table I shows the total number of carcinoma cervix cases operated on, with the incidence of primary mortality. The primary mortality rate in my series is 5.4 per cent. Out of 6 fatal cases, 3 died of shock, 1 of sepsis, 1 of pulmonary embolism and 1 of staphylococcus septicæmia. This is in conformity with the average primary mortality rate in radical vaginal operations, *i.e.*, 7.7 per cent (Mickuliez Radecki), whereas the average primary mortality rate in radical abdominal operations (the so-called Wertheim's operation) is 18 per cent (Pankow). Table II shows the distribution of cases according to different grades as classified by the League of Nations. An incidence of primary mortality has also been given against different grades. This table shows that 2 patients of the first grade died, of two rare complications, namely, pulmonary embolism and staphylococcus septicæmia. Three patients

TABLE I

*Total number of carcinoma cervix cases operated on, with the incidence of primary mortality*

|                                  | Total number | Primary mortality |   |
|----------------------------------|--------------|-------------------|---|
| Seva Sadan                       | 94           | 4                 | 3 died of shock.<br>1 died of sepsis.                                 |
| Carmichael Medical College.      | 15           | 2                 | 1 died of pulmonary embolism.<br>1 died of staphylococcus septicæmia. |
| Madras Govt. Hospital for Women. | 1            | nil               |   |
| Total                            | 110          | 6 (5.4%)          |   |

TABLE II

*Distribution of cases according to the grades of the League of Nations with incidence of primary mortality*

| Grade | Total number | Primary mortality |   |
|-------|--------------|-------------------|---|
| I     | 17           | 2                 | 1 died of pulmonary embolism.<br>1 died of staphylococcus septicæmia. |
| II    | 58           | 2                 | 1 died of shock.<br>1 died of sepsis.                                 |
| III   | 35           | 2                 | Shock.  |
| IV    | nil          | ..                |   |

died of shock, which could be accounted for by their devitalized and anæmic condition when they come for treatment.

Although much work has been done to find out the optimum dose of radium treatment, the ideal one has not yet been found. Generally 6,000 'milligramme hours' is unsatisfactory as a method of dosage in that it neglects the important factors of distribution and radium-tumour distance and so cannot be accurately and satisfactorily utilized by others.

Recent investigations recommend 10,000 r radium as the lethal dose\*; similarly 5,000 r x-ray with 2.5 cu. H.V.L. and average 1.09 A.U. has been found to be the lethal x-ray dose in about a month's time. Figure 1 shows the isodosis chart for the radium tubes pointing out how the intensity of radium r-unit decreases according as the distance increases. This figure shows that within 3 cm. from the site of radium application, the intensity is reduced to half and within 6 cm. it is reduced to about one-sixth the original intensity. This shows that unless the

\*7.6 r/hour is the radiation measured at 1 cm. from a point source of 1 mg. of radium filtered by 1 mm. platinum.



distant parametrial tissues are further exposed by x-ray, the effective lethal dose will not be available there. Figure 2 shows the isodosis chart of x-ray in the pelvis where the most lateral part of the pelvis will receive an effective dose. Table III shows the deep x-ray dosage given by the writer in his cancer cervix cases.

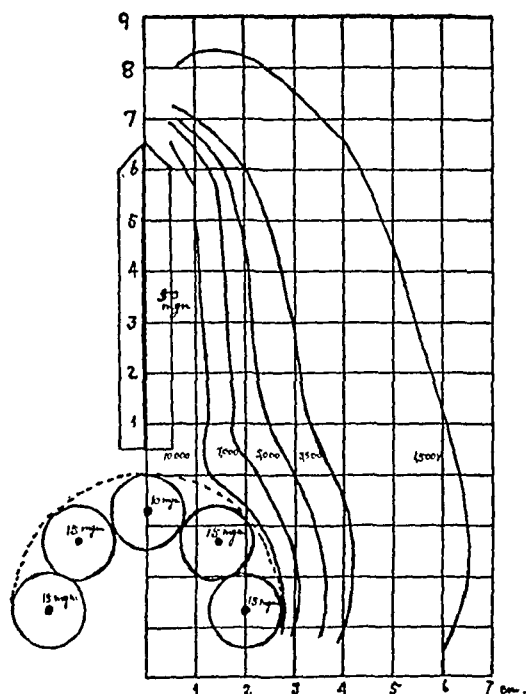


Fig. 1.—Isodosis chart for radium tubes: within 3 cm. from the site of application, the intensity is reduced to half and within 6 cm. to about one-sixth the original intensity.

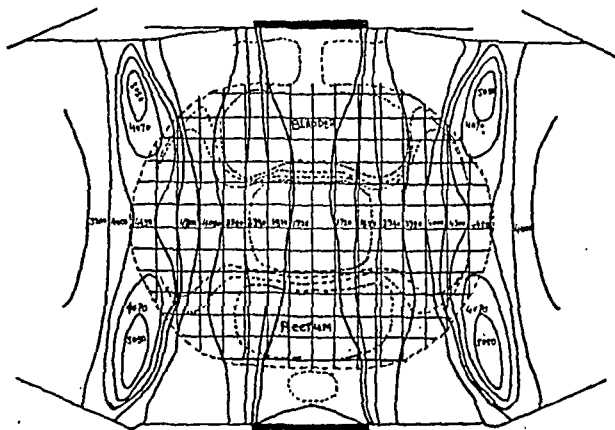


Fig. 2.—Isodosis chart for x-ray in the pelvis where the most lateral part receives an effective dose.

Table IV shows the results of operation given year by year up to 5 years. Twenty-eight cases have already been lost sight of and, not being able to trace them, we have taken them as dead to evaluate our 5-year end-results.

Table V shows 5-year end-results of carcinoma cervix cases treated only by radiation (1926 to 1932).

Table VI shows 5-year salvage of carcinoma cervix cases treated by operation and radiation

TABLE III

Deep x-ray technique for carcinoma-cervix cases—5 fields: 2 abdominal, 2 gluteal, 1 vulval, 220 K.V., 15 mA, 1.5 m.Cu., 50 cm. F. S. D. 25 exposures—at 300 r daily.

| Day  | Skin dose in air | Effective dose 10 cm. deep (33%) including back scatter (15%)* | Daily loss at 8% | Total effective dose |
|------|------------------|--|------------------|----------------------|
| 1st  | 300              | $300 + 45 = 345$   | ..               | 145                  |
| 2nd  | 300              | $115 + 115 = 230$  | 9                | 221                  |
| 3rd  | 300              | $115 + 221 = 336$  | 17               | 319                  |
| 4th  | 300              | $115 + 319 = 434$  | 25               | 409                  |
| 5th  | 300              | $115 + 409 = 524$  | 32               | 492                  |
| 6th  | 300              | $115 + 492 = 607$  | 39               | 568                  |
| 7th  | 300              | $115 + 568 = 683$  | 45               | 638                  |
| 8th  | 300              | $115 + 638 = 753$  | 50               | 703                  |
| 9th  | 300              | $115 + 703 = 818$  | 60               | 758                  |
| 10th | 300              | $115 + 758 = 873$  | 65               | 808                  |
| 11th | 300              | $115 + 808 = 923$  | 69               | 854                  |
| 12th | 300              | $115 + 854 = 969$  | 72               | 897                  |
| 13th | 300              | $115 + 897 = 1,012$  | 76               | 936                  |
| 14th | 300              | $115 + 936 = 1,051$  | 79               | 972                  |
| 15th | 300              | $115 + 972 = 1,087$  | 82               | 1,005                |
| 16th | 300              | $115 + 1,005 = 1,120$  | 84               | 1,036                |
| 17th | 300              | $115 + 1,036 = 1,151$  | 87               | 1,064                |
| 18th | 300              | $115 + 1,064 = 1,179$  | 89               | 1,090                |
| 19th | 300              | $115 + 1,090 = 1,205$  | 91               | 1,114                |
| 20th | 300              | $115 + 1,114 = 1,229$  | 93               | 1,136                |
| 21st | 300              | $115 + 1,136 = 1,251$  | 95               | 1,156                |
| 22nd | 300              | $115 + 1,156 = 1,271$  | 96               | 1,175                |
| 23rd | 300              | $115 + 1,175 = 1,290$  | 98               | 1,192                |
| 24th | 300              | $115 + 1,192 = 1,307$  | 99               | 1,208                |
| 25th | 300              | $115 + 1,208 = 1,323$  | 100              | 1,223                |

\* Maximum back scatter with 1.5 m.cu. H.V.L. and with an area  $10 \times 10$  at 10 cm. depth is 15 per cent.

TABLE IV

Evaluation of results of operative cases

| Year | Total cases | Living years |    |    |    |    | L.S.O. | REMARKS  |
|------|-------------|--------------|----|----|----|----|--------|--|
|      |             | 1            | 2  | 3  | 4  | 5  |        |  |
| 1932 | 4           | 4            | 1  | 1  | 1  | 1  | 1      | (1 fr. 1st year)                               |
| 1933 | 4           | 4            | 2  | 1  | 1  | 1  | 2      | (2 fr. 1st year)                               |
| 1934 | 17          | 17           | 10 | 7  | 7  | 4  | 6      | (3, 1, 1 and 1 fr. 1st, 2nd, 4th and 5th year) |
| 1935 | 12          | 12           | 11 | 9  | 7  | 4  | 3      | (3 fr. 4th year)                               |
| 1936 | 16          | 16           | 10 | 6  | 5  | .. | 7      | (4, 2 and 1 fr. 1st, 2nd and 3rd year)         |
| 1937 | 19          | 19           | 10 | 9  | .. | .. | 5      | (5 fr. 1st year)                               |
| 1938 | 9           | 9            | 4  | .. | .. | .. | 3      | (3 fr. 1st year)                               |
| 1939 | 4           | 4            | .. | .. | .. | .. | 1      | (1 fr. 1st year)                               |

during the years 1932 to 1935. A comparative review of the two foregoing tables will clearly show that on an average the operative cases give better end-results. Taking the first three grades together the operative cases yield 27 per cent 5-year salvage whereas cases treated only by radiation yield 14.4 per cent.

Table VII gives a comparative statement of the world literature drawn up by Adler with the author's result appended below. This table shows that, in spite of manifold difficulties, our

results are comparable with the results obtained in other parts of the world.

TABLE V

5-year results of carcinoma cervix cases treated only by radiation (1926 to 1932)

| Stages                  | Total number of cases | LIVING AFTER 5 YEARS |            |
|-------------------------|-----------------------|----------------------|------------|
|                         |                       | Number               | Percentage |
| I                       | 13                    | 7                    | 53.4       |
| II                      | 56                    | 21                   | 37.5       |
| III                     | 361                   | 34                   | 9.4        |
| IV                      | 60                    | 1                    | 1.7        |
| All stages together.    | 490                   | 63                   | 12.9       |
| I, II and III combined. | 430                   | 62                   | 14.41      |

TABLE VI

5-year results of carcinoma cervix cases operated on during 1932 to 1935

| Grade                | Total number | LIVING |            |
|----------------------|--------------|--------|------------|
|                      |              | Number | Percentage |
| I                    | 2            | 1      | 50         |
| II                   | 20           | 8      | 40         |
| III                  | 15           | 1      | 7          |
| IV                   | nil          | ..     | ..         |
| All grades together. | 37           | 10     | 27         |

TABLE VII

A comparative statement of world literature on 5-year results of carcinoma cervix cases, with the author's results appended.

|                       |                           |        |       |
|-----------------------|---------------------------|--------|-------|
| Radiation             | World literature ..       | 17.45% |       |
|                       | Forsell-Heyman ..         |        | 23.3% |
|                       | Bowing-Fricke ..          |        | 23.0% |
|                       | George Gray Ward ..       |        | 23.6% |
| Operation             | World literature ..       | 19.1%  |       |
|                       | Bonney (abd.) ..          |        | 25.0% |
|                       | Schauta (vag.) ..         |        | 22.5% |
| Operation + Radiation | Franque (abd.) ..         |        | 28.1% |
|                       | Peham (vag.) ..           |        | 28.0% |
|                       | Adler (vag.), 3rd method. |        | 31.8% |
| Do.                   | Mitra (vag.) ..           |        | 27.0% |

### Summary

1. An analysis of 110 cases of carcinoma cervix, operated on by the radical vaginal method after Schauta and subsequently irradiated by radium and deep x-rays, has been given.

2. Primary mortality is 5.4 per cent.

(Concluded at foot of next column)

## PNEUMONITIS

By L. EVERARD NAPIER, C.I.E., F.R.C.P. (Lond.)  
R. N. CHAUDHURI, M.B. (Cal.), M.R.C.P. (Edin.),  
T.D.D. (Wales)

and

M. N. RAI CHAUDHURI, M.B. (Cal.)

(From the School of Tropical Medicine, Calcutta)

APART from the classical examples of lobar and broncho-pneumonia, the differences between the lung diseases of adults and of children are considerable, and the so-called atypical forms, including central pneumonia, are common in the latter. Recently, cases with a low-grade inflammatory pulmonary change of a benign nature have been described by both American and English workers. The symptoms include a cough, low pyrexia, and lassitude. The physical examination does not reveal any evidence of pneumonia. Weak breath sounds and a few râles are perhaps the only auscultatory findings. The respiration rate is not increased, and there is no toxæmia. The x-ray film reveals some opacity suggesting a localized inflammatory process in the lung. There is nothing in the history to suggest that the condition is the end of a pneumonia, or an unresolved pneumonia. The disease runs a benign course and usually clears up rapidly.

The term 'pneumonitis' has been applied to this clinical entity; it has the same meaning as pneumonia, namely, an inflammatory condition of the lung, a different word being used to indicate the non-specific nature of the reaction, as well as a different ætiology.

In this connexion the following case seems worth reporting:—

A Jewish female child, aged 1½ years, was admitted into the Carmichael Hospital for Tropical Diseases on the 24th April, 1939, with a complaint of cough and low

(Continued from previous column)

3. A few hints on the technique of the operation have been given.

4. The principles of post-operative radiation technique have been explained.

5. A comparative statement of evaluation of 5-year end-results of both surgically treated and irradiated cases has been given. Taking I, II and III grades together, 5-year cure of surgically treated cases (supplemented by radiation) is 27 per cent against 14.4 per cent in only irradiated cases.

6. It is possible to improve further the end-results if the cases can be detected at earlier stages, if proper pre-operative treatment can be given, if the technique of the operation be followed efficiently, and if radium and deep x-ray apparatus be at the disposal of the surgeon, and finally the number of 'lost sight of' cases can be minimized.

### REFERENCE

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intermittent fever for one week. There was no history of any previous illness, and the parents stated that there was no tuberculosis in the family.

The child showed some evidence of retarded growth; she had a rectal temperature of 100.4°F., pulse 140, and a respiration of 28 per minute. There was no dullness over the chest; the air entry was weaker on the right side; and scattered râles and ronchi were audible in both lungs. The spleen and liver were palpably enlarged. A few cervical glands were palpable. No abnormality was detected in the ear, nose or throat.

The blood count showed hæmoglobin 56 per cent (7.7 gm.) and total leucocytes 13,500 per c.mm. The differential count showed polymorphonuclears 74 per cent, lymphocytes 23 per cent, monocytes 2.5 per cent and eosinophils 0.5 per cent. The stool examination revealed a mild hookworm infection. The urine was clear.

The Mantoux test was negative with 10000 mgm. and 1000 mgm.

No sputum was obtainable; tubercle bacilli were not found in the gastric juice.

*X-ray examination.*—Skiagram of the chest was taken at intervals during the child's stay in the hospital (plate XIII).

### Discussion

This is a case with radiological opacity in the lung, suggestive of pneumonia but with a remarkable paucity of symptoms and signs. The low intermittent fever, the milder leucocytosis, the absence of any toxæmia or increase in respiration and the physical signs do not offer any clinical support to a diagnosis of pneumonia. Besides, the *x-ray* density is neither lobar nor of typical broncho-pneumonic distribution. It is difficult to consider it to be due to unresolved pneumonia in the absence of any history of a recent attack of pneumonia.

Tuberculous enlargement of the hilar glands and an allergic reaction in the lungs would be a reasonable interpretation of any of the skiagrams in this case, but the negative Mantoux reactions and the subsequent progress seem to negative this diagnosis.

In the past, more-or-less similar cases have been described as sub-acute or chronic pneumonia, atypical pneumonia or 'symptom-poor' pneumonia. In recent years, it has been recognized that such inflammatory changes in the lungs running a benign course are relatively common, and it is to this type of case that the term 'pneumonitis' has been applied.

Blake and Cecil (1920), as a result of experimental pneumococcal infections in monkeys, showed that the pneumococci enter through the mucous membrane of the main bronchus and then pass through the lymphatics of the lung giving rise to an interstitial inflammation. With the progress of the inflammatory process the blood becomes infected and exudate fills the alveoli, resulting in consolidation of lung tissue.

Maxwell (1938) is of the opinion that the course in the human subject depends upon the resistance of the patient and the virulence of the organism. In the presence of good, general and local, resistance with an infection of low virulence the organisms give rise to interstitial pneumonitis, but the process stops short at this stage and there is only a little exudation into the alveoli. The temperature and pulse may be

raised, but the respiration is not hurried; there is no toxæmia. The diagnosis depends upon *x-ray* examination. On the other hand, if the general immunity mechanism breaks down, the inflammatory process will progress to consolidation of the lung, and the patient will exhibit evidence of toxæmia that is characteristic of pneumonia. 'A patient with pneumonitis will develop pneumonia if the resistance fails, or lung abscess may result from local tissue damage. The clinical picture varies considerably in different cases'.

This view of regarding the condition as a mild or abortive pneumonia of acute specific type has, however, been disputed. There are many instances in which bacteriological studies of the sputum and blood have failed to reveal pneumococci. Sulphonamide derivatives are usually ineffective in this disease; the case under review also bears out this fact. It has been suggested that the condition is due to virus rather than bacterial infection, hence the condition has also been called 'virus pneumonia'. Some workers consider it to be more infectious than pneumonia and have reported epidemic outbreaks. Different opinions have been expressed as to the nature of virus in different outbreaks, e.g., the virus of Q fever, psittacosis. There is, however, no evidence to show that it is due to the influenza virus.

Smiley *et al.* (1939) applied the term acute interstitial pneumonitis to this condition and considered it to be a new disease entity. They studied eighty-six cases. They observed that the radiological opacity appears about the second day of illness, and that the infection spreads from the hilus outward. According to the *x-ray* appearance, they divided the cases into three groups. In the first group the onset was marked by increased hilar density, 'with a fan-shaped localized accentuation and a numerical increase in the linear pulmonic markings extending from the hilus into the adjacent lung field'. They usually clear up in one to two weeks' time. In the second group the fan extended to the periphery of the lung, and it took a longer time to clear up. In the third group, there was more severe and extensive involvement. Almost an entire lung is affected as well as partial or complete involvement of the other lung. This may be associated with a higher rise in temperature and some toxæmia. The resolution is slow and may take a few weeks or months. Mild leucocytosis often occurs. The condition usually terminates with little or no complication.

The more severe forms of the disease occasionally prove fatal, and a few autopsies have been performed. The pathological lesions were found distinct from those of pneumonia.

### Conclusion

This case illustrates an acute benign infection of the respiratory tract in which a skiagram of the chest revealed fan-shaped

(Concluded on opposite page)

PLATE XIII  
SKIAGRAMS WITH REPORTS

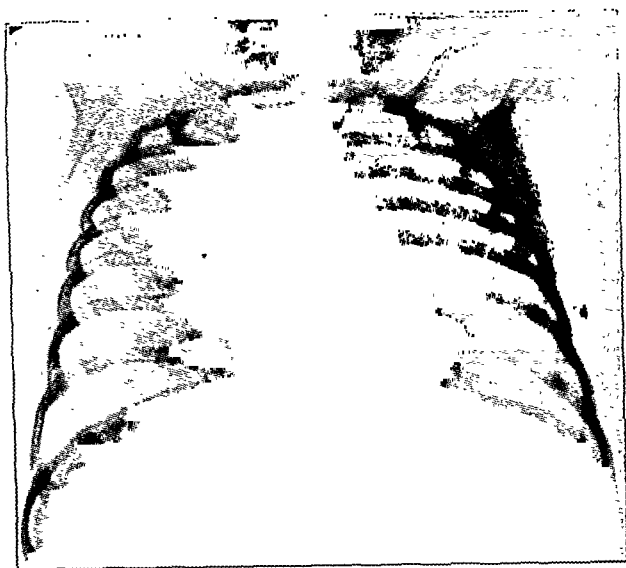


Fig. 1. 5th June



Fig. 2 (oblique view). 29th June

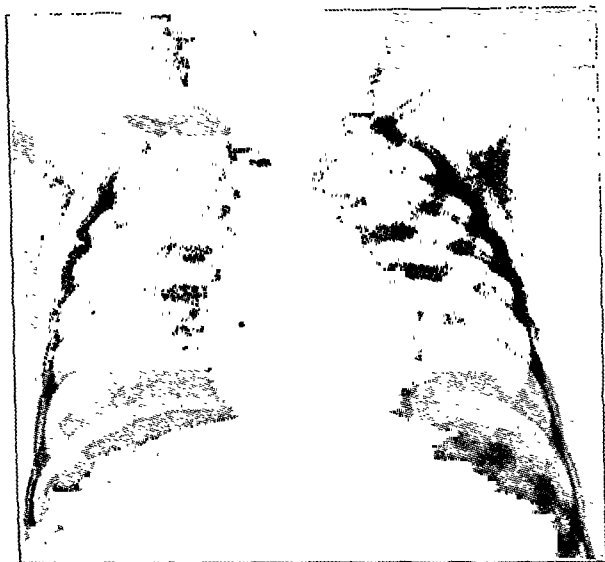


Fig. 3. 13th July

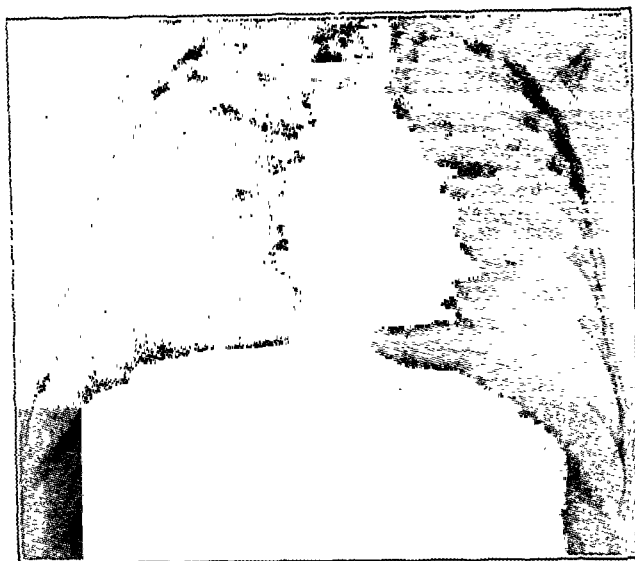


Fig. 4. 7th August

5th June.—There is a homogeneous opacity in the right lung field extending outwards from the hilum and shading off towards the periphery. This occupies the greater part of the upper zone and the inner two-thirds of the middle zone.

On the left side there is an opacity similar in distribution but of the type of a dense mottling.

The extreme apices on both sides are comparatively free.

The appearances suggest a lobar pneumonia starting in the left upper lobe which is now resolving, and a more recent involvement of the right upper and middle lobes.

29th June.—The opacity on both sides is less extensive though perhaps more dense mesially. The apices and clear peripheral lung are now more evident.

13th July.—The film shows a further contraction of the opaque areas.

7th August.—The clear areas have further extended. The consolidation on the left side has almost completely cleared up while that on the right side has become less dense.

*Conclusions.*—According to our present knowledge of these conditions in children this series of skiagrams would seem to portray the gradual resolution of a pneumonic process. It is difficult to differentiate here between a pure pneumococcal infection and tuberculous disease.

There are two shadows which might be due to enlarged glands—skiagrams of 5th June and 29th June. Such an appearance would support the diagnosis of tuberculous disease. Time, however, alone will tell. A pneumococcal or allied pneumonia should clear up completely.

#### *Clinical progress*

While she was in the hospital, the child had irregular intermittent fever. Sulphonamide derivatives and quinine were given empirically but without effect; otherwise the treatment was palliative. The general condition gradually improved very considerably; the child put on 3½ lb in weight during her stay in the hospital. The radiological opacity, however, persisted, but it was definitely reduced (*vide* skiagram, 7th August).



## HEPATOMA (PRIMARY LIVER-CELLED CARCINOMA)\*

By A. C. BOSE, M.B.

*Pathologist, Mayo Hospital, Calcutta*

HEPATOMA is uncommon; it usually occurs in the second half of life and is accompanied with cirrhosis of the liver. This is more frequent in males than females.

This has been estimated by Forsyth (1922) to constitute 4 per cent of liver cancers and of these a good proportion accompanies a cirrhotic process. At St. Mary's hospital out of 2,083 autopsies in 10 years (1919-1928) there were 372 examples of malignant growths, out of these three were liver-celled carcinoma and seven bile-duct carcinoma, as noted by Langmead (1938). Gharpure (1927) has mentioned 14 cases of primary carcinoma of liver from 6,000 odd *post-mortem* cases in the course of 50 years from 1877-1926 from the Grant Medical College, Bombay, but he remarked two cases only being primary liver-celled carcinoma. This is more common in many tropical countries (about 1 per cent of necropsies) than Europe and North America (about 0.2 per cent of necropsies).

Chatterjee (1926) in his paper on cancer in India mentioned that this is very often preceded by cirrhotic changes in the liver induced by parasitic infections and chronic amœbiasis; and that this is due to the toxin of parasitic infections which cause chronic irritation of the liver tissue and cell proliferation resulting in cirrhosis and hyperplasia—the precursor of cancer. While discussing the ætiological aspect, some other factors (*e.g.*, climate, diet, influence of heat and light, influences due to peculiarities in habits and customs of the indigenous population and their effect on metabolism through the endocrine system) have also been considered. So far I have gathered that there is no record of a case of hepatoma in a child in any of the Indian journals with micro-photographs of the morbid histological changes.

\*This specimen of hepatoma was exhibited at the All-India Surgeon's conference, held in Calcutta, 1941, and was presented to the Pathological Museum, Medical College, Calcutta.

(Continued from previous page)

areas of increased density that are apparently not due to true consolidation, or pneumonia, nor is there any evidence to suggest a diagnosis of tuberculous disease. This appears to be a case of acute interstitial pneumonitis, a condition that is now being generally recognized.

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The incidence of primary liver-celled carcinoma has also been noted in animals. Winer and Schroeder (1940) reported hepatocellular carcinoma in a roe-deer; this is not usually preceded by cirrhosis but starts from benign adenoma and is ascribed to strongyloides infestation of the small intestine as being the ætiological factor.

Fieldman and Jackson recorded it in dogs, sheep, cattle and Norries in a fowl (rooster), among the domestic animals.

*Morbid anatomy.*—On naked-eye examination the whole liver may present one single tumour or may be a collection of nodules of different sizes projecting from the surface, or there may be a diffuse infiltration.

The irregularly shaped bossed organ may become of enormous size and may be nearly all replaced by growth, the remaining liver tissue showing a coarser or finer cirrhosis. The right lobe is usually affected; the colour of the tumour varies from light yellow to light grey, but occasionally it is bile-stained.

The nodules are hard and perhaps stony in resistance, in the less rapidly growing forms, but usually the bosses become soft and even fluctuant, sometimes from necrosis with or without hæmorrhage and from suppuration. The bosses are sometimes marked by depression at their summits; matting of the liver is the result of perihepatitis.

Microscopically primary carcinomas of the liver are divided into (1) liver-celled carcinoma (hepatoma), or (2) bile-duct carcinoma (cholangioma), originating in the walls of the finest bile ducts. In hepatoma the masses of cells look like liver cells but are larger and more variable in size and shape (including giant cells), the nuclei are irregular, darkly staining, and show numerous mitosis. The cells are sometimes bile stained and there is characteristic vascular stroma between them. The origin of the tumour (hepatoma) either in ordinary liver cells or in benign adenomas is not decided but when accompanied by cirrhosis it arises in the actively growing cells of regeneration nodules. The tumour invades blood vessels, fills their lumen with tumour 'thrombus', spreads along them throughout the liver by intra-hepatic metastasis, and may reach the right heart by direct extension. Extra-hepatic metastasis is rather rare; lungs and lymphatic glands are first involved.

### Clinical features

1. *Cirrhosis* marked by general ill-health and digestive disturbance is the usual accompaniment in hepatoma in adults, this is either manifested early or remains latent, but in infants may be absent altogether.

2. *Pain* is usually of a dragging character felt over the liver, or in the epigastrium (unrelated to food) or in the right shoulder and may be reflected to the right arm, or pain may be altogether absent.



3. *Jaundice* appears in about half of the cases as a result of intra-hepatic obstruction of the bile channels, or by compression of the larger ducts in the portal fissure by secondary glands, or by cholangitis. Pipe-clay coloured stools are not a constant finding.

4. *Ascites* is almost always present and is caused by invasion of the portal vein by the growth or by secondary glands in the portal fissure or by obliteration of the branches of the portal vein in the liver. The character of the ascitic fluid varies; it may be serous or chyliform due to necrosis of the nodules, or purulent from secondary infection but is usually blood stained due to hæmorrhage.

5. *Edema* of the legs is caused by the mal-nutrition and circulatory failure in the later stages.

6. The *general condition* of the patient is characterized by increasing anæmia, weakness and emaciation; finally, the extreme shallow lustreless look of the patient with prominent abdomen in a markedly wasted frame becomes a striking picture. Fever almost always accompanies the illness. With the rapid enlargement of liver there may be produced pressure symptoms, e.g., vomiting from pressure on the stomach and dyspnoea from that on the diaphragm. In the terminal stages the patient is carried away either by broncho-pneumonia, internal hæmorrhage or pleurisy with effusion resulting in extreme exhaustion and sleeplessness, usually ending in delirium and coma.

#### *Diagnosis and differential diagnosis*

Hepatoma is characterized by hard and irregular liver with multiple bosses, rapid enlargement, rapid development of wasting and anæmia, and the presence of pain and tenderness.

It is to be distinguished from other enlarged, hard, or irregular livers due to syphilis and hydatid disease of the liver.

In syphilis there is absence of pain, slow enlargement specially of the left lobe of the liver, visible signs of collateral circulation, absence of extreme cachexia, signs of congenital syphilis in infants, and a positive Wassermann reaction.

Hydatid disease of the liver usually provides a smooth, resilient, soft and non-adherent swelling; and is characterized by the presence of a thrill, absence of cachexia and pressure-symptoms and presence of eosinophilia and positive precipitin tests.

#### *Case report*

Hindu male child, aged 6, was admitted on 27th April, 1940, with a history of fever of 2 months' duration and protuberant abdomen. At the time of admission he was found to be very weak and extremely emaciated. Conjunctiva was pale and anæmic. The pulse was regular but of low tension and volume.

On examination.—There was marked ascites and œdema of the lower extremities, liver was found to be

nodular, hard and enlarged 3 inches below the costal margin, the dullness also increased upwards to the 4th interspace. Spleen was just palpable. There were no palpable glands. Heart and respiratory system were normal and nothing else abnormal was found.

Blood count—red cells 2,520,000 per c.mm., some anisocytosis; hæmoglobin 50 per cent; colour-index, 0.98; white cells 14,800 (polymorphonuclears 71 per cent, lymphocytes 25 per cent, monocytes 4 per cent, eosinophils 0 per cent), aldehyde and antimony tests negative.

The patient died on 3rd May, 1940.

*Post-mortem findings.*—Heart weighing 2½ ounces was normal and so also was the pericardium.

*Abdomen.*—There were 5 pints of hæmorrhagic fluid inside the peritoneal cavity; the mesentery was not involved. Spleen weighing 5 ounces was normal. Kidney—right one weighing 2 oz. and left one weighing 2½ oz. were found normal. Supra-renal—normal. Liver was found to be fairly enlarged, with an irregular surface. Its weight was 2 lbs. and 4 oz. The whole of the right lobe was occupied by a growth with round irregular masses of different sizes projecting from the surface. The mass showed an area of necrosis and softening leading to bursting and throwing out of its contents leaving a cavity with ragged walls. A few small dark-coloured (hæmorrhagic) cysts were seen. A few secondary nodules of irregular sizes were detected in the left lobe. The quadrate lobe was enlarged and tongue-shaped while the cut surface showed a cirrhotic appearance. The gall-bladder was thin-walled and very small in size, while the cystic duct was seen to be pressed by the enlarged quadrate lobe. Cut section of the tumour showed whitish rounded soft masses in the liver tissue (plate XIV, figure 1).

*Microscopical appearance* showed rounded masses of enlarged liver cells of different sizes and having deeply stained nuclei undergoing mitoses. These are interspersed with healthy liver cells in different degrees of degeneration and showing spaces filled with degenerated cell debris. There is distinct proliferation of fibrous tissue round the groups of malignant cells (figures 2 and 3).

#### *Summary*

1. Hepatoma is a rare disease.
2. It is more uncommon in a child of 6 years.
3. The detailed description of the case has been presented with the photograph of the liver and microphotographs of the morbid histological changes.

#### *Acknowledgments*

The writer acknowledges his indebtedness to Dr. F. H. B. Norrie, Surgeon Superintendent, Mayo Hospital, for his kind interest and permission to publish this case. Thanks are also due to Dr. B. P. Tribedi, professor of pathology, Medical College, for the microphotographs.

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## TUBERCULOSIS OF THE HEART

(SIMULATING A NEOPLASM)

By A. C. BOSE, M.B.

Pathologist, Mayo Hospital

TUBERCULOUS infection of the pericardium occurs as a part of general infection and is usually caused by the rupture or extension of caseous lymph nodes laden with *Mycobacterium tuberculosis* into the serous cavity. The miliary tubercles may also appear in the myocardium and also on the endocardial surface, but this is not of common occurrence. The tuberculous heart becomes enlarged due to thickening of the pericardium and sometimes presents the appearance of a neoplasm and can hardly be diagnosed prior to death. The following case illustrates this fact :—

## Case report

A Hindu male, aged 25 years, was admitted into the hospital on 19th March, 1941.

**History.**—The patient gave a history of cough, fever, and palpitation on exertion for more than a month; he also noticed gradual swelling of legs and feet for about 2 months.

**On examination.**—Patient was emaciated, with puffy appearance of the face, œdema of the lower extremities having red flush (pitting on pressure), and slight bulging of the abdomen.

**On admission :** temperature—102°F., pulse—118, and respiration—44 per minute, temperature was ranging from 98°F. to 100°F. usually, but sometimes went up to 102°F.

**Lungs.**—Slight expectoration; right side—dullness at the base; left side—dullness at the back; both lungs were full of râles and ronchi. After a month the dullness seemed to have increased on the left base, and there was dyspnoea; two months after there was a swelling on the third sterno-costal articulation, attended with tenderness and fluctuation. (This was not reduced by iodide.) Six months after, left axillary glands were enlarged and there was another fluctuant swelling on the right second sterno-costal joint. Glands at the left supra-clavicular fossa were also enlarged and hard.

**Abdomen.**—There was shifting dullness and ventral hernia. Liver and spleen were enlarged and tender.

**Heart** was enlarged, apex beat was displaced and faintly audible; after about 2 months clubbing of fingers was noticed; the swelling of legs and feet was diminished for some time but later went on increasing and involved the genital organs. There was marked ascites.

## Laboratory findings

**On admission.**—Blood : hæmoglobin—50 per cent (Sahli), white cells—7,100 per c.mm., red cells—2,550,000 per c.mm., neutrophils—75 per cent, lymphocytes—15 per cent, mononuclears—7 per cent, eosinophils—3 per cent. Aldehyde test—negative; antimony test—negative; Kahn's test—negative; Wassermann reaction—strongly positive. Stool : no ova nor any parasite or any cyst found. Urine : albumin—trace, sugar—nil, reaction—acid. Microscopically triple phosphates and epithelial cells present. Sputum : streptococci, staphylococci and diplococci were found, but no *Mycobacterium tuberculosis* was detected.

**On 23rd July.**—Blood : hæmoglobin—40 per cent, white cells—5,800 per c.mm., neutrophils—81 per cent, lymphocytes—17 per cent, monocytes—2 per cent, eosinophils—0 per cent. Kahn's test—doubtful. Wassermann reaction—strongly positive. Sputum : presence of streptococci, staphylococci, diplococci.

*Mycobacterium tuberculosis* was absent. Urine : albumin present (not estimated), sugar—nil. Microscopically amorphous phosphates, ammonium urates and triple phosphates were present. Blood on culture—there was no growth after 48 hours on three successive examinations.

## X-ray report

The x-ray examination of the chest on 18th April showed enlargement of cardiac shadows; both the arches of the diaphragm appeared hazy, possibly due to pleuritic condition and chronic bronchial catarrh of the bases.

On the 24th July, in another x-ray examination, dense appearance over the mediastinum masking the cardiac shadow suggesting a new growth was noticed.

## Post-mortem findings

**Lungs.**—miliary tubercles were found to be scattered over the lungs with inter-lobar adhesions. There was bilateral pleurisy with some effusion and adhesion in places. Bronchial glands were matted together and caseous.

**Liver and spleen** were enlarged and studded with small tubercles on their surface. They weighed 3 pounds, 12 ounces and 1 pound, 4 ounces, respectively.

**Chest.**—fluctuant swelling; on excision cheesy purulent material was found.

**Abdomen.**—mesenteric glands were also involved; the intestine was very slightly affected, only very few scattered small tubercles were detected at the ileo-cæcal region. There were about 9 pints of fluid in the peritoneal cavity.

**Heart.**—to the naked eye the heart appeared as a neoplasm (figure 1). It was pale, enlarged and weighed

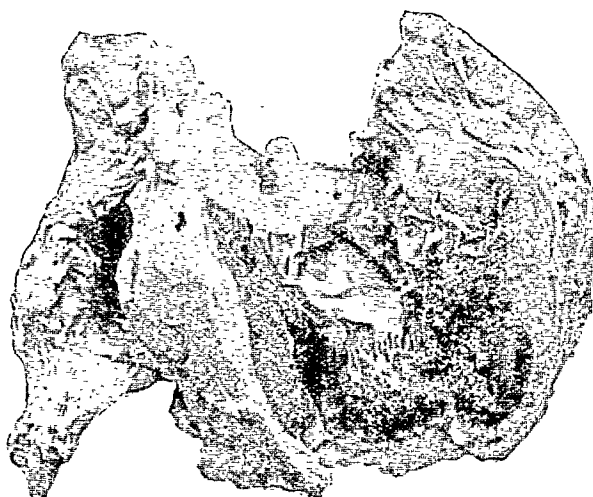


Fig. 1.\*—Photograph of the heart—simulating a neoplasm. It has been cut open to show greatly thickened pericardium, pale myocardium but normal endocardium.

1 pound and 3 ounces. The pericardium was greatly thickened (varying from 2 cm. to 2.5 cm. in depth), the parietal and visceral layers could hardly be separated. The pathological process of the pericardium also involved the myocardium, but the endocardium was not affected. No definite tubercles were visible either on the surface of the pericardium or in the substance of the heart muscle.

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\* This specimen was presented to the pathological museum, Medical College, and exhibited at the All-India Surgeon's Conference (1941).

## OSTEOPOIKILOSIS WITH DISSEMINATED LENTICULAR DERMATOFIBROSIS

WITH THE REPORT OF A CASE

By MADAN LAL AGGARWAL, M.B., B.S.  
Lahore

### Case report

PATIENT, Hindu female, aged 20, was admitted to the Sh. Gulab Devi Tuberculosis Hospital for Women with fever, cough, dyspnoea on exertion, loss of weight, poor appetite and night sweats. Duration of illness before admission was six months. There was no history of previous illness. A brother died of pulmonary tuberculosis. Examination of circulatory, digestive and urogenital systems did not reveal any pathology. Chemical and microscopic examination of urine did not reveal any abnormality. Stools were negative for ova and cysts. Her sputum contained tubercle bacillus. On radiological and clinical examination she showed active tuberculosis of the right lung. She is getting artificial pneumothorax.

During her stay in the hospital she developed swelling on her thenar (right) and interscapular regions. X-ray picture of the dorsal spine did not reveal any disease but the shoulder joints in this picture showed dense white spots. Diagnosis of osteopoikilosis was made and x-ray pictures of all the joints of the body, spine and skull were taken (plate XV).

The skin of thighs and arms was covered with tiny lentil-sized nodules. This condition is known as lenticular dermatofibrosis.

### The bone condition

*Roentgen description.*—White dense spots which were multiple, round or somewhat oblong, circumscribed but sometimes confluent were seen in the spongiosa of the epiphysis and metaphysis of long bones. Their size varied from a diameter

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*Lymph glands*—showed marked caseous changes.

Other organs were found to be normal.

Histological examinations of the different organs, e.g., liver, spleen, lungs, heart, etc., all showed typical tuberculous infection with caseation-necrosis and conspicuous giant-cell systems.

The section from the heart shows wide areas of necrosis in the pericardium and many giant cells and lymphoid cells in the myocardium (plate XIV, figures 2 and 3).

### Summary

A case of tuberculosis of heart is described. This is of interest because clinical symptoms and repeated x-ray findings suggested this case to be a neoplasm of the heart and even the naked-eye appearance after *post-mortem* examination gave the same impression. This was finally diagnosed to be tuberculous from the microscopical study.

### Acknowledgments

My sincere thanks are due to Dr. F. H. B. Norrie, Surgeon Superintendent, Mayo Hospital, for the interest and kind permission to report this case, to Dr. B. P. Tribedi, professor of pathology, Medical College, for the photo-micrographs, and to Dr. P. K. Ghosh, physician, Mayo Hospital, for the clinical materials.

of 1 mm. to an area of  $4 \times 15$  mm. In this case all the bones were involved except the ribs and the clavicles. The greatest number of the spots were seen in the bones of the pelvic girdle. The central portions of the iliac wings were free from these spots. The elbow joint was least involved. The spots were smallest near the joints but increased in size further away from the joints. The spots arranged themselves along the general direction of the principal trabeculae. In the shafts of the long bones the spots were elongated. They were observed with regard to their number roughly in the following order: pelvic girdle, shoulder joint, carpal bones, tarsal bones, knee bones, metacarpals, metatarsals, skull and spine. Other observers have recorded the condition in the clavicles also. Thus, the condition affects all the bones except the ribs. Even the sesamoid bones have been involved.

*Prognosis* is very good. A wrong diagnosis can put a patient to a good deal of worry, expense and wrong treatment. The condition is usually found by accident as was the case in this patient. Newcomet (1929) noted no roentgenographic changes in the lesions exhibited by his patient during four years of observation and the case reported by Nichols and Shiflett (1934) showed no changes during a period of seven years.

Albers-Schönberg is generally credited with having reported the first case in 1915, but according to Koenig the disease reported by Albers-Schönberg was an entirely different clinical entity. According to Bloom (1933) the first authentic report of osteopoikilosis was that by Stieda, in 1905, who reported 'cases of circumscribed condensing of the bone in the region of the substantia spongiosa, based on roentgen examination of macerated bone and anatomical specimens.'

### Pathology

Schmorl performed the first reported autopsy of a case in 1931. Nichols and Shiflett (1934) have abstracted from the pathological report of Schmorl as follows:—

'Pathological examination showed that the areas which had shown as increased bone density on the roentgenograms varied from needle-head to pepper-grain size and were seldom larger. These were irregular and had somewhat jagged borders, and on the saw plane surface had homogeneous, greyish white areas, appearing as small osteomas. They were partly round and partly oval. The areas of osteopoikilosis were compact and entered the spongiosa plates and trabeculae as small nodular formations. Almost never did these areas lie immediately in the bony terminal lamina of the epiphysis on which the joint cartilage is fastened, but were of a greater or lesser distance from it. Only in the surface of the intermediary cartilage were they at times situated on the latter. Those which lay on the spongiosa section of the diaphysis were almost never in the axial plane of the spongiosa, but rather in the periphery where the spongiosa trabeculae attached to the bone rims, which at this point were not very thick.

The microscopic examination showed that the areas of increased density were formed by numerous juxtaposed trabeculae resembling those of the spongiosa more than of the cortex. This close arrangement gave the appearance of compact bone which was observed

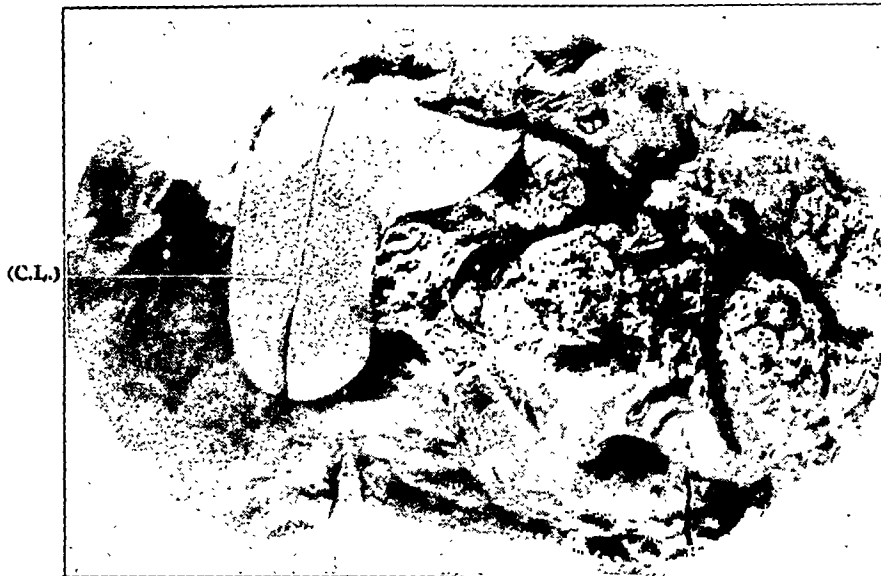


Fig. 1.—Photograph of the liver showing irregular nodular masses mostly in the right lobe with a few dark coloured cysts, tongue shaped enlarged caudate lobe (C.L.) and a small gall-bladder.

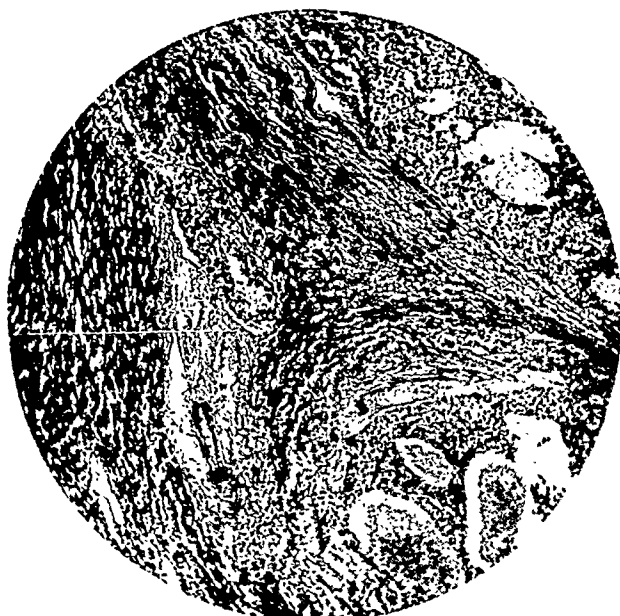


Fig. 2.

Fig. 2.—Photomicrograph of the liver showing normal liver cells undergoing degeneration and some assuming atypical appearance. The proliferation of fibrous tissue around cell masses and areas with degenerated cell-debris are distinctly noticeable.  
Ocular—8 ×.  
Objective—10 mm.



Fig. 3.

Fig. 3.—Photomicrograph of the liver showing rounded masses of liver cells of different sizes and darkly stained irregular nuclei with mitotic figures.  
Ocular—8 ×.  
Objective—6A.

#### TUBERCULOSIS OF THE HEART

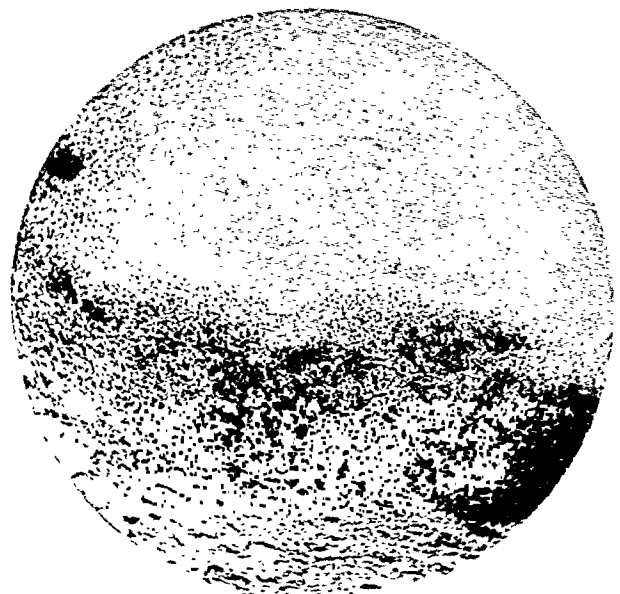


Fig. 2.

Fig. 2.—Photomicrograph of the section from the wall of the heart showing caseation necrosis (in the pericardium) and many giant cells in the myocardium, as minute black specks.  
Eye piece—8 ×.  
Objective—10 mm.

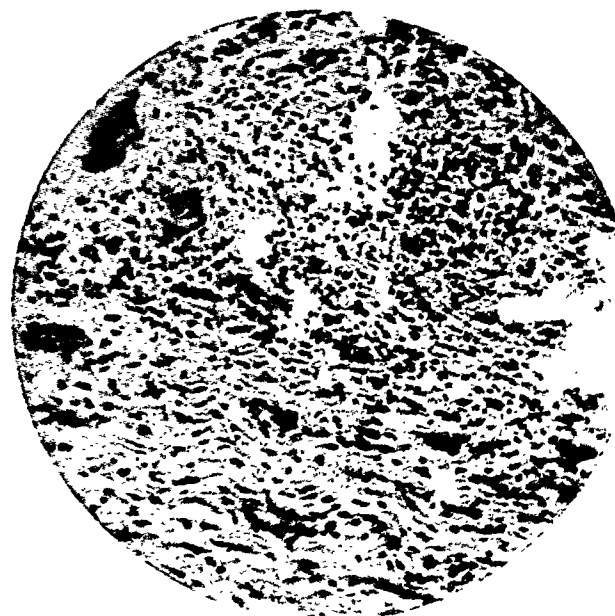


Fig. 3.

Fig. 3.—Photomicrograph of the same section showing giant cells in the myocardium.  
Eye piece—8 ×.  
Objective—8 mm.



Fig. 1.



Fig. 2.

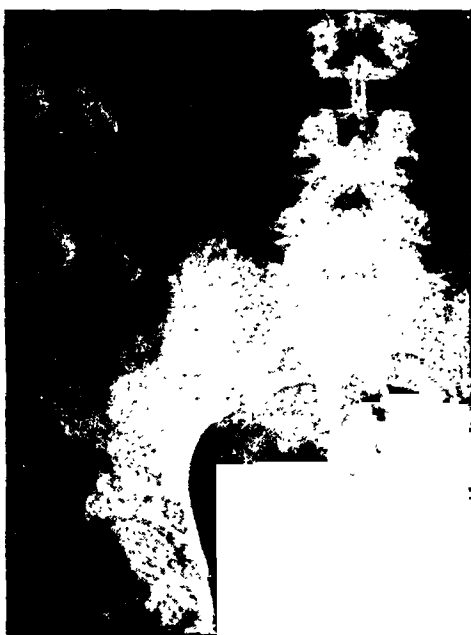


Fig. 3



Fig. 4.

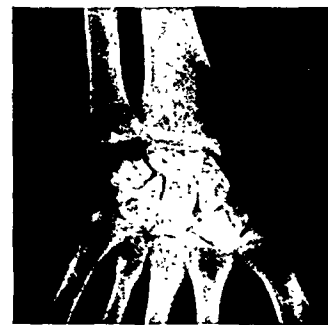


Fig. 5.



Fig. 6.

while studying the gross specimens. The merging of the trabeculae into the spongiosa was gradual and sharply defined borders were absent. The trabeculae were thin at times, at other times they formed tufts in which the thickness of the trabeculae varied. The thickened ones consisted of lamellous bone arranged mostly parallel to the long axis of the bone but a few were obliquely arranged, while some were grouped chiefly in the periphery, concentrically around blood vessels, without a typical osteomatous formation.

The histologic study did not permit definite conclusions as to the genesis of the trabeculae. The author thought that they probably arose from the fibrous portion of the bone marrow. It was not possible to determine whether the areas of osteopoikilosis increased in size after they were once formed. Schmorl stated that this would have to be determined by repeated roentgen examination at regular intervals. He did not consider an enchondral origin probable as the areas of increased density were not connected with the enchondral zone of growth and areas of cartilage were not observed in any of the numerous areas described above.

### *Ætiology*

Windholz, Wilcox (1933), Svab (1932) and Voorhoeve believe the condition to be hereditary. The bones of the hand of a paternal uncle of our case did not reveal the condition. Typhoid, tuberculosis and diabetes have been variously described as factors contributing to the appearance of this condition, but many of the reported cases do not give any such histories and the condition has been found accidentally in healthy individuals, although our case is also suffering from pulmonary tuberculosis. Blood calcium and phosphorus were normal in the cases in which these were estimated, only Windholz has recorded a slight deviation in the calcium and phosphorus metabolism in the blood of two of his three cases.

In the cases reported by Pokorny and Pokorny, Windholz, Svab (1932), Curth (1934) and Buschke and Ollendorf a disseminated lenticular dermatofibrosis was noted. Our case also shows this skin condition and we are of the opinion that there is some definite relationship between these two conditions. If this condition is looked for in cases of osteopoikilosis more such associations will be recorded. We would have missed this condition had we not read an abstract of the paper by Windholz. According to Windholz comparative histological investigation revealed that the foci of osteopoikilosis were the result of islands of compact bone, showing normal osseous structure, whereas the skin changes were the result of fibrotic changes of the cutis, such as described by Buschke and Ollendorf. Voorhoeve thinks that this condition is due to a disturbance of enchondral ossification and should be grouped under dyschondroplasias. Wilcox (1933) thinks it is due to a congenital cartilage anlage. Schmorl's findings do not favour Voorhoeve's theory and Wilcox's idea does not explain the association of disseminated lenticular dermatofibrosis. The best conclusion seems to be that of Schmorl who thinks the condition to have developed from a congenital anlage without committing the type of the anlage. It is also interesting to note that

Schmorl thought it probable that this condition rose from the fibrous portion of the bone marrow. Perhaps we will be nearest the truth if we say that the condition develops from a mesodermal anlage. This will explain the association of the two conditions. A further investigation of these conditions may throw more light on the process of ossification. Schmorl stated that he found no evidence of inflammation or infection. Bacterial embolism has also been advanced as a possible cause, but without sufficient supporting evidence.

### *Skin condition*

The skin of the thighs and arms was covered with tiny lentil-sized nodules. The colour of the nodules was the same as that of the surrounding skin which was wheat coloured. The patient had these prominences since her birth; they never altered in size.

### *Pathology*

This condition of disseminated lenticular dermatofibrosis was first described by Buschke and Ollendorf in 1928. Their case was a woman of forty-one years of age who was of an infantile build. The skin of shoulders, lower abdomen, gluteal regions and both thighs of this woman showed a net-like arrangement of lentil-sized rather regular prominences. Microscopically, there was evidence of a fibrous thickening of the cutis without the characteristics of tumour formation and with maintenance of the elastic fibres.

The relationship between the two conditions has been discussed above.

### *Comment*

Osteopoikilosis is a very uncommon condition. One can hardly quote fifty cases from the world literature. On looking up the Indian medical literature we did not come across any previous report of this condition. We, however, do not believe that the condition is so rare as that, but it must be admitted that it is quite uncommon. In cases showing the bone condition the skin should be examined for disseminated lenticular dermatofibrosis. We are sure that if this is done their co-existence will be reported more frequently. We believe that the scantiness of the number of cases reported is due to incorrect diagnosis. We hope that more case reports will follow from this country. A wrong diagnosis can put a patient to lot of expense, worry and inconvenience of wrong treatment. A correct diagnosis, on the other hand, will mean a very good prognosis and no treatment will be needed for this condition.

### *Summary*

1. A case of osteopoikilosis of bones with disseminated lenticular dermatofibrosis is reported.

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# PECULIAR SEROLOGICAL BEHAVIOUR OF A STRAIN OF *LEPTOSPIRA* *CANICOLA*

By B. M. DAS GUPTA

(From the School of Tropical Medicine, Calcutta)

THIS strain was received on 9th July, 1941, from the Lister Institute, London. Since then it has been maintained by subculture on Vervoort's medium.

On 14th October, 1941, a specimen of serum from a case of febrile jaundice was sent to the department for agglutination reaction for leptospiral infection. The serum was put up against all the strains of leptospira then available in the laboratory, viz, strain Chopra (classical *L. icterohæmorrhagiæ*), Mg. Tin Tin (= Java bat strain), Andaman CH 31, Andaman CH 11, and *L. canicola*. It failed to agglutinate all these strains except *L. canicola*. In the latter a few definite clumps were seen and there was also some evidence of lysis in dilutions up to 1 : 80. A week later another specimen from the

before and with identical results. This persistent quality of the serum to agglutinate and lyse in low dilutions the dog strain of leptospira could not be explained. This strain was therefore treated with the serum of a person who had never had jaundice in his life. In this case also the serum in low dilutions tended definitely but not markedly to agglutinate and lyse the leptospiræ up to 1 : 40. But the same serum used 15 days later gave an entirely negative reaction with the strain, thus showing that the agglutinating and lytic properties exhibited by the serum in the fresh state were lost by keeping. It was further noticed that fresh sera heated at 56°C. for 30 minutes also lost these properties.

An anti-serum was prepared by intravenous injection of a rich culture of this organism into a rabbit at intervals of 4 days. After 10 injections the rabbit was bled and the serum was found to react to a titre 1 in 1,000,000. The titre of the anti-serum was not, however, affected by heating. Finally, in order to ascertain if this leptospira will also agglutinate with the normal sera of other animals we procured

Table showing titre of agglutination of various animal sera with the *L. canicola* and some other strains of leptospira

|                                       | TITRE WITH         |                 |               |               |             |
|---------------------------------------|--------------------|-----------------|---------------|---------------|-------------|
|                                       | <i>L. canicola</i> | <i>L. icter</i> | Andaman CH 31 | Andaman CH 11 | Mg. Tin Tin |
| Serum, dog .. .. .                    | 1 : 80             | 0               | 0             | 0             | 0           |
| " monkey ( <i>Silenus rhesus</i> ) .. | 1 : 40             | 0               | 0             | 0             | 0           |
| " " ( <i>S. irus</i> ) ..             | 1 : 40             | 0               | 0             | 0             | 0           |
| " rabbit ..                           | 1 : 40             | 0               | 0             | 0             | 0           |
| " horse .. .. .                       | 1 : 40             | 0               | 0             | 0             | 0           |
| " hen .. .. .                         | 1 : 20             | 0               | 0             | 0             | 0           |
| " ass .. .. .                         | 1 : 40             | 0               | 0             | 0             | 0           |
| " goat .. .. .                        | 1 : 20             | 0               | 0             | 0             | 0           |

same individual was received and agglutination tests were carried out with the same strains as

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2. There is a close relationship between these two conditions and the importance of examination of the skin in cases of osteopoikilosis is emphasized.

3. It is hoped that more case reports of these conditions will follow from this country.

I have to thank the medical superintendent and the staff of the Sh. Gulab Devi Tuberculosis Hospital for Women for their sympathetic co-operation, and Dr. K. L. Wig, M.R.C.P. (Lond.), for constructive criticism.

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absolutely fresh samples of sera from a dog, two different species of monkeys, a rabbit, a horse, a hen, an ass and a goat, and tests were carried out with the dog strain and some other strains of leptospira isolated in Calcutta and elsewhere.

The results are shown in the table above.

## Summary and conclusion

It will be seen from the foregoing results that many fresh human and animal sera agglutinate a dog strain of leptospira in low dilutions up to 1 : 40 and 1 : 80 and that this property is lost when the serum is kept or heated. As such agglutinating reactions are apt to lead to errors in the diagnosis of leptospiral infection it is important to remember that some strains of leptospira may exhibit the property. The points to remember about such agglutinations are (i) that they are seen only in low dilution; (ii) that only fresh sera exhibit the property; (iii) that the property is lost when the serum is kept or heated to 56°C. for 30 minutes. Although none of the 4 strains available in this laboratory for diagnosis of human leptospiral

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# A COMPARATIVE STUDY OF THE CAPSULAR REACTION AND THE AGGLUTINATION TEST IN THE TYPING OF PNEUMOCOCCUS

By N. G. PANDALAI

*From the Department of Bacteriology, Andhra Medical College, Vizagapatam*

As early as 1902, Neufeld observed that the capsulated pneumococcus showed a peculiar change when it was treated with its specific anti-serum, but for a number of years the important practical value of this reaction had not been realized and until our knowledge that there are several serological types of pneumococcus was fully established this reaction had not been utilized in the typing of the organism. Later on, Neufeld and Etinger-Tuleynska (Topley and Wilson, 1936; Armstrong, 1932; Logan and Smeall, 1932; Sabin, 1933) and a number of other workers demonstrated the value of this reaction for the immediate typing of pneumococci. To-day, the capsular reaction, or Neufeld reaction as it is sometimes called, is done in many laboratories as a routine measure for the detection of the type causing lobar pneumonia. However, in view of the accumulating evidence for the efficacy of chemotherapeutic preparations in the treatment of lobar pneumonia, it would appear that the motive for immediate typing of the organism may cease to operate and only the purely scientific value of it will remain.

The capsular reaction is done either immediately with the sputum or any exudate containing the organism, or with the mouse's peritoneal exudate aspirated five to six hours after inoculating the animal intraperitoneally with the infective material. Mouse inoculation is resorted to to concentrate the coccal content in the test material. A well-developed capsular coating is essential to bring out this reaction effectively. Even in the best of cultural conditions capsule formation does not take place so satisfactorily as to produce reliable response. Hence concentration of the organism by cultural methods is useless for the performance of this reaction. Besides, it is time consuming. Mouse

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infection behaved in a similar manner yet the possibility of other strains exhibiting this property when mixed with normal serum or with sera of persons suffering from diseases other than leptospiriosis should be borne in mind. As specific agglutinins are not destroyed by heating to 56°C. for half an hour, this procedure may be adopted in cases of doubt.

[After the report was sent to the press, Sir John Taylor, who very kindly studied the strain at my request, informed me that after sub-culture on Fletcher's medium the spirochæte did not agglutinate with the sera of guinea-pigs and horses, and showed doubtful reaction with rabbit's serum in 1 in 20. The difference in the results might be due to the use of different media.—B. M. DAS GUPTA.]

inoculation obviates these difficulties and sufficient peritoneal fluid can be aspirated for typing by either the Neufeld reaction or the agglutination test.

Two other serological methods are available for typing. They are the agglutination and the precipitation reactions. Obviously both are unsuitable for immediate typing. The capsular reaction, though time saving, is not regarded by all authorities as equally reliable as the agglutination test. As specificity is a factor of the capsular substance, the agglutination test should be carried out only with the smooth cultures.

In this article, the writer has endeavoured to show that a simple method of capsular reaction done with adequate care about details is equally as reliable as the agglutination test. Both capsular reaction with sputum and agglutination test with cultures were done individually on 60 different strains of pneumococcus contained in such materials as sputum, pus and cerebrospinal fluid obtained from various sources and the results are studied.

On receipt of each specimen a smear was made and examined for the presence of pneumococcus after staining by Gram's method. Next it was seeded in duplicate on 6 per cent rabbits' blood agar plates for isolation of the organism and inoculated at 37°C. The positive material was then emulsified with four times its volume of sterile normal saline. This process has undoubted advantages as otherwise practical difficulties will be encountered in titrating the tenacious sputum with the serum and longer time would be required for the serum to soak into the fleck of sputum. Besides, with an emulsion a rough quantitative adjustment of the reagents is possible. It would also obviate any error due to unequal distribution of the organism in the gelatinous sputum. For reliability it is essential that the test should be conducted on fresh specimens; otherwise sharp differentiation may not be possible. Having made the emulsion the capsular reaction is done on it immediately. Save for some slight modification, the technique followed is the one that was kindly demonstrated to me by Dr. W. R. Logan in his laboratory at Edinburgh. The specific serum employed throughout this work was the Wellcome brand of anti-pneumococcal rabbit serum and as this firm could not supply all the type sera, it was found necessary to confine this work to the two dominant types—I and II. Three slides were used for each specimen. On slide labelled I and marked off into two halves by a grease pencil line, two loopfuls of the emulsion were placed on each of the two halves. A loopful of Loeffler's methylene blue was placed near one of these and two loopfuls of type I serum near each. They were then mixed separately, covered with coverslips, and rimmed with vaseline. A similar preparation was made with the second slide but substituting type II serum in the place of type I while the third with no serum formed the control. The preparations

were examined after ten minutes by the 1/12 immersion lens under slightly restricted illumination. In positive cases the unstained greenish-white capsule both in the stained and unstained specimen appears very much swollen and in the former stands out in strong relief to the blue surroundings and to the blue-black lanceolate central dots constituting the organism apparently reduced in size. Such reacting pneumococci arrest the attention immediately.

A comparative study of the stained and unstained preparations revealed that the former has more advantages than the latter. Methylene blue has not been found to interfere with the potency of the serum in this particular. Not uncommonly specimens of sputum are encountered in which, while the majority of pneumococci react to the specific serum, a fair number of the typical capsulated diplococci remain apparently unaffected. Probably this may be due to the inevitable admixture of the sputum with mucus containing other types from the throat and the mouth. Mixed infection with more than one type may also explain this inertness. The only difficulty encountered was

that an occasional strain of *M. tetragena* also showed a capsular swelling, particularly with type I serum, but with a little experience this difficulty would vanish. It was also noticed that when a specimen is taken late in the course of the disease, either a higher dilution of the emulsion or a greater proportion of the serum was found necessary to bring out the capsular swelling prominently. Type II pneumococcus presented a wider capsular zone than type I. Whether it is due to any larger amount of specific substance present in the capsule of this type is not evident. As stressed by workers in this field capsular reaction is independent of the agglutinating action.

After twenty-four hours of incubation of the plates a number of green colonies appearing to possess the characteristic features of pneumococcal colonies was subcultured from each plate into tubes of serum broth of pH 7.6 and these were again incubated. These were tested the following day by Gram's method for identification. What appeared to be pneumococcal cultures were inoculated separately into inulin serum water tubes and put into the incubator.

TABLE

| Specimen number | Material          | Capsular |      | Agglutination | Bile solubility | Inulin A.C. | REMARKS  | Specimen number | Material          | Capsular |      | Agglutination | Bile solubility | Inulin A.C. | REMARKS  |      |
|-----------------|-------------------|----------|------|---------------|-----------------|-------------|--|-----------------|-------------------|----------|------|---------------|-----------------|-------------|--|------|
|                 |                   | Type     | Type |               |                 |             |  |                 |                   | Type     | Type |               |                 |             |  |      |
|                 |                   |          |      |               |                 |             |  |                 |                   |          |      |               |                 |             |  | Type |
| 2               | C.S.F.            | 2        | 2    | +             | +               |             | Meningitis.<br>(Blood culture positive for type II). | 54              | Sputum            | 1        | 1    | +             | +               |             | Empyema.<br>No pneumococcus in the smear but culture positive. |      |
| 3               | Sputum            | 1        | 1    | +             | +               |             |  | 55              | "                 | 2        | 2    | +             | +               | +           |  |      |
| 4               | "                 | 1        | 1    | +             | +               |             |  | 56              | "                 | 1        | 1    | +             | +               | +           |  |      |
| 5               | "                 | 1        | 1    | +             | +               |             | 57   | "               | 1                 | 1        | +    | +             | +               |             |  |      |
| 7               | Pus               | 2        | 2    | +             | +               |             | 58   | Pus             | 1                 | 1        | +    | +             | +               |             |  |      |
| 8               | Sputum            | 1        | 1    | +             | +               |             | 61   | Sputum          | 0                 | 1        | +    | +             | +               |             |  |      |
| 9               | "                 | 1        | 1    | +             | +               |             | Testicular abscess.                                  |                 |                   |          |      |               |                 |             |  |      |
| 11              | Peritoneal fluid. | 1        | 1    | +             | +               |             |  | 64              | "                 | 1        | 1    | +             | +               | +           |  |      |
| 12              | C.S.F.            | 1        | 1    | +             | +               |             |  | 65              | Peritoneal fluid. | 1        | 1    | +             | +               | +           |  |      |
| 13              | Sputum            | 2        | 2    | +             | +               |             | 67   | Sputum          | 1                 | 1        | +    | +             | +               |             | Peritonitis.   |      |
| 17              | "                 | 2        | 2    | +             | +               |             | 68   | "               | 1                 | 1        | +    | +             | +               |             |  |      |
| 20              | "                 | 1        | 1    | +             | +               |             | 69   | Pus             | 1                 | 1        | +    | +             | +               |             |  |      |
| 21              | "                 | 1        | 1    | +             | +               |             | Do.  |                 |                   |          |      |               |                 |             | Retro-pharyngeal abscess.                                      |      |
| 22              | "                 | 1        | 1    | +             | +               |             |  | 70              | Sputum            | 2        | 2    | +             | +               | +           |  |      |
| 23              | "                 | 1        | 1    | +             | +               |             |  | 71              | "                 | 1        | 1    | +             | +               | +           |  |      |
| 24              | "                 | 1        | 1    | +             | +               |             | 74   | "               | 1                 | 1        | +    | +             | +               |             |  |      |
| 25              | "                 | 1        | 1    | +             | +               |             | 75   | "               | 1                 | 1        | +    | +             | +               |             |  |      |
| 26              | "                 | 1        | 1    | +             | +               |             | 76   | "               | 1                 | 1        | +    | +             | +               |             |  |      |
| 27              | "                 | 1        | 1    | +             | +               |             | 77   | "               | 1                 | 1        | +    | +             | +               |             |  |      |
| 28              | Pus               | 1        | 1    | +             | +               |             | 78   | "               | 1                 | 1        | +    | +             | +               |             | Empyema—from No. 24.   |      |
|                 |                   |          |      |               |                 |             | 79   | "               | 2                 | 2        | +    | +             | +               |             |  |      |
| 34              | Sputum            | 2        | 2    | +             | +               |             | 81   | "               | 1                 | 1        | +    | +             | +               |             |  |      |
| 38              | Sinus discharge.  | 2        | 2    | +             | +               |             | 84   | "               | 1                 | 1        | +    | +             | +               |             |  |      |
| 39              | Sputum            | 1        | 1    | +             | +               |             | 85   | "               | 1                 | 1        | +    | +             | +               |             |  |      |
| 40              | "                 | 1        | 1    | +             | +               |             | 86   | Pus             | 2                 | 2        | +    | +             | +               |             |  |      |
| 45              | "                 | 1        | 1    | +             | +               |             | 87   | Sputum          | 2                 | 2        | +    | +             | +               |             | Empyema.   |      |
| 48              | Pus               | 2        | 2    | +             | +               |             | 90   | "               | 1                 | 1        | +    | +             | +               |             |  |      |
| 49              | Sputum            | 2        | 2    | +             | +               |             | 91   | "               | 1                 | 1        | +    | +             | +               |             |  |      |
| 50              | "                 | 1        | 1    | +             | +               |             | 92   | Pus             | 1                 | 1        | +    | +             | +               |             | Empyema.<br>Meningitis.  |      |
| 52              | "                 | 2        | 2    | +             | +               |             | 93   | C.S.F.          | 2                 | 2        | +    | +             | +               |             |  |      |
| 53              | "                 | 2        | 2    | +             | +               |             | 94   | Sputum          | 1                 | 1        | +    | +             | +               |             |  |      |
|                 |                   |          |      |               |                 |             | 98   | "               | 1                 | 1        | +    | +             | +               |             |  |      |

All the morphologically pneumococcal cultures from the same plate were mixed, about 5 c.cm. were removed to a sterile test tube and the rest was killed in the water-bath at 56°C. for 30 minutes. The 5 c.cm. quantity was then tested for bile solubility. In the beginning the reagent employed was 10 per cent sodium taurocholate adding 5 drops of it to 5 c.cm. of culture, but it was unsatisfactory often producing only a slight turbidity, even in some of those cases where the organism was subsequently proved to be pneumococcus by the serological methods. Later, a 10 per cent sodium desoxycholate was substituted with entirely satisfactory results. Use of Hartley's broth is preferable to serum broth in the execution of this test.

Next, the agglutination test following Dreyer's method was done with the killed culture, incubating the stands for two hours at 56°C. and reading the results on the following morning, although in most of the cases rapid agglutination took place as in the case of flagellar agglutination. The results were entered parallel with those of capsular reaction, inulin fermentation, and bile solubility (*see table*).

In the above series only those cases where clumping took place in a dilution of 1 in 80 or more have been included. The blank in the 'remarks' column represents cases of lobar pneumonia.

It was noted that the method of dissolving the organism with bile salt does not interfere with its antigenic property; for when the homologous serum was added to the clear solution a thick precipitate was formed while the control remained unaffected. In the case of empyema fluid, or cerebro-spinal fluid, the supernatant fluid from a centrifugalized specimen also produced in low dilutions the precipitation phenomenon on the addition of the specific serum.

The table brings out the fact that there was agreement between the capsular reaction and the agglutination reaction in 58 out of 60 cases. In specimen 61 the smear did not show the presence of pneumococcus while the culture was positive, and in specimen 70 there was disagreement between these two reactions. About 75 per cent of cases are due to the first and the second types. The table also reveals a close correlation between the capsular and the agglutination reactions. Therefore, it would appear that the method of direct typing is adequate, at any rate, in those positive cases of capsular reaction and to proceed further to mouse inoculation or culture for confirming the type for therapeutic purposes would seem to be unnecessary. Only when the organism is very scanty in the specimen does enrichment by mouse inoculation become necessary.

#### Conclusion

Direct typing of pneumococcus from the sputum or other material is, with rare excep-

(Concluded at foot of next column)

## IN VIVO ACTION OF SOME SUBSTANCES ON THE PROTEOLYTIC SYSTEM IN BLOOD

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THE possibility of the changes in the proteolytic system that may be brought about by certain therapeutic substances has been studied in the present paper. The changes in the trypsin content of blood in certain pathological conditions have been reported by Iyengar *et al.* (1942). From these experiments it was considered likely that changes in the trypsin content may be reliable index of changes in nitrogen metabolism. The accumulation of the proteolytic enzymes in blood in certain diseases like nephritis, and its significant reduction in other diseases like cancer and anæmia, etc., were particularly observed. If such abnormal changes in an important constituent of blood take place as a result of the specific pathological condition, it should be the endeavour of the biochemist to investigate the action of drugs that may be able to counteract this tendency. It is, however, not suggested that the rectification of this particular abnormality will cure the specific disease. A study of this kind may help the clinician to give a fair therapeutic trial to those drugs which may be found to have an effect on the proteolytic system opposite to the one brought about by the specific pathological condition. The present study has, therefore, been undertaken with this object, as well as to throw light on the complex proteolytic system reported to be present in blood.

The use of cobra venom in the therapy of cancer has been recommended by Calmette *et al.* (1933) and largely extended by Chopra and Chowhan (1935) and his collaborators. They

(Continued from previous column)

tions, as reliable as the agglutination reaction. The addition of Löffler's methylene blue to the reagents in the slide method does not interfere with the capsular reaction and is advantageous.

#### Acknowledgment

My thanks are due to the members of the medical staff of the King George's Hospital for the supply of specimens.

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report that in most cases the patient is considerably relieved of the pain and this they ascribe to the neurotoxin that is reported to be present in cobra venom. The other explanation is that the venom contains a proteolytic enzyme which acts on the tumour tissue, thus bringing about an improvement in the condition of the patient. This is rather untenable on account of the fact that the amount of trypsin present in the cobra venom is too small to exert any lytic effect, when injected in the doses recommended by the above authors.

The protease in cobra venom has been investigated by Iyengar *et al.* (1938) and found to be a trypsin which is not highly active at a pH near neutrality. The *in vivo* action of the venom on the proteolytic system of blood has not been reported. In view of the significant decrease of the trypsin content of blood in cancer, the rationale of the treatment of this malignant disease by cobra venom may be explained in the light of the results of such a study. Further, Chopra and his collaborators (1937) have reported that the clotting time of blood from a monkey is accelerated by the injection of small doses of cobra venom and is inhibited when the dose of the venom exceeds a particular limit. No satisfactory explanation based on any experimental evidence is offered by them for this rather interesting observation. They merely visualize the possibility of digestion of fibrinogen by the large dose of cobra venom. In view of the rôle played by trypsin in the process of coagulation, it occurred to us that *in vivo* changes in plasma trypsin might be brought about by the injection of the venom.

Current evidence indicates that the oxidation-reduction state of the medium probably plays a determining rôle with respect to the direction in which proteolytic enzymes (particularly cathepsin) act. Bersin and Logemann (1933) investigated enzymic proteolysis as influenced by oxidizing and reducing agents. They observed that mild reducing agents activate proteolysis; whereas oxidants, such as hydrogen peroxide and benzo-quinone, inhibit the reaction. Excessive oxidation or reduction destroys the enzyme itself. Reiss (1938, 1939), who studied this problem in its physico-chemical relation, finds that at a pH near 7.4 the proteolytic activity decreases sharply in a medium where the potential is more positive than + 50 millivolts or more negative than - 100 millivolts. With lower pH value (4.9) there is a shift to a more positive range between + 500 millivolts and + 50 millivolts.

In the light of this interesting phenomena, it was considered exceedingly interesting to study the *in vivo* action of substances like vitamin K. The study of the action of vitamin K in this respect is of particular interest, since it plays an important rôle in the synthesis of prothrombin which is a globulin protein. One of the suggested mechanisms of prothrombin formation is that vitamin K activates protein synthesis, by tending to inhibit proteolysis. There is, however, no

suggestion that vitamin K promotes the synthesis of any other protein except prothrombin. Its action in synthesizing prothrombin should be regarded as remarkably specific.

The *in vivo* action of various doses of 2-methyl-1 : 4 naphthaquinone (synthetic vitamin K) is reported in the present communication.

### Material and methods

**Cobra venom.**—This was obtained from the School of Tropical Medicine through Capt. J. S. Chowhan.

**2-methyl-1 : 4 naphthaquinone.**—This was prepared by us in the laboratory by the oxidation of 2-methyl naphthalene. The crystals were dissolved in olive oil under sterile conditions before using for injections.

Determinations of free plasma trypsin and total plasma trypsin were made according to the method described in our previous communications (Iyengar *et al.*, 1942).

**Determination of trypsin content in red blood corpuscles.**—The blood corpuscles are first washed with normal saline and centrifuged twice. Two c.cm. of the washed corpuscles are laked with distilled water and the solution is then precipitated with 4 volumes of acetone. The precipitate obtained after centrifuging is washed well with acetone. The tryptic activity of this precipitate is determined as above.

**Determination of catheptic activity of serum.**—Two c.cm. serum are precipitated with acetone, centrifuged, and the residue washed twice with acetone. After ordinary drying this precipitate is made into a fine suspension with 10 c.cm. of 1 per cent casein in phosphate buffer of pH 7.0 and the increase in NPN determined after incubation as usual.

### Experimental

The experiments were carried out on two dogs kept under controlled conditions in the laboratory animal house. Before we study the action of drugs on the trypsin content of plasma, it is necessary to ascertain the limits within which the trypsin content of the same dog may vary from day to day.

TABLE I

| Days | Dog No. 1 |       | Dog No. 2  |       |
|------|-----------|-------|--|-------|
|      | Free      | Total | Plasma trypsin expressed as increase in NPN for 100 c.cm. plasma |       |
|      |           |       | Free   | Total |
| 1    | 18.5 mg.  | 61.8  | 22.8   | 69.4  |
| 2    | 23.2 mg.  | 58.8  | 28.4   | 76.5  |
| 3    | 20.9 mg.  | 65.6  | 20.5   | 62.6  |
| 4    | 24.8 mg.  | 69.8  | 26.6   | 65.8  |

The free trypsin and the total trypsin in plasma appear to remain fairly constant in each dog.

The effect of injecting various doses of cobra venom intramuscularly on the free trypsin content of plasma was next studied, and the results are given below:—

Weight of the dog = 7 kilograms. Blood was taken for each determination 2 hours after injection of the venom. The injections were given once in 72 hours.

TABLE II

| Dose of venom | Trypsin in 100 c.cm. plasma | Dose of venom | Trypsin in 100 c.cm. plasma |
|---------------|-----------------------------|---------------|-----------------------------|
| <i>nil</i>    | 25.5 mg.                    | 0.10 mg./kilo | 90.9 mg.                    |
| 0.03 mg./kilo | 65.3 "                      | 0.12 "        | 107.2 "                     |
| 0.05 "        | 72.2 "                      | 0.15 "        | 46.6 "                      |
| 0.07 "        | 79.2 "                      | 0.19 "        | 17.3 "                      |

There is a significant rise in the free trypsin content of plasma after the injection of cobra venom. This increase is, however, not maintained. At the end of 24 hours the trypsin content tends to decrease and within 48 hours it comes to its original level. The cause of this increase in trypsin can be explained in different ways. The venom itself has tryptic activity (Ghosh, 1936; Ghosh and De, 1936; Iyengar, Sehra and Mukherji, 1938) and the increase brought about may simply be an additive effect. This is extremely unlikely, since the actual amount of trypsin that is present in the quantities of the venom injected is extremely small and is further diluted by the circulating blood. The dilution of the venom in the blood after injecting the dose of 0.12 mg./kilo, which brings about a maximum increase in trypsin, is found by calculation to be 1 in 700,000. In such a microscopic quantity of the venom, the trypsin present is practically negligible. Since the blood plasma contains, in addition to free trypsin, a compound of trypsin-inhibitor which is normally inactive, but which can be activated by a kinase, the possibility that the venom might contain the trypsin-kinase has to be considered. In order to test this possibility the following experiments were undertaken:—

Plasma was precipitated directly with acetone and the precipitate was dried after washing with acetone twice. This contains the trypsin-inhibitor compound as well as the small quantity of free trypsin. If this compound could be split up by the addition of cobra venom in a concentration of 1 in 20,000 (which is very much higher than the maximum concentration of the venom in blood after the injection), and consequently increased trypsin activity demonstrated, it could then be regarded as sufficient evidence of the presence of trypsin-kinase.

The above results clearly disprove the possibility of the presence of trypsin-kinase in cobra venom, since there is practically no increase in the tryptic activity of plasma trypsin on the *in vitro* addition of the venom.

TABLE III

*In vitro* action of cobra venom on plasma proteins

|   | Increase in NPN after 48 hours |
|---|--------------------------------|
| 1. (a) 100 mg. acetone precipitated plasma proteins incubated in 10 c.cm. buffer of pH 8.4. | 0.25                           |
| 2. (a) + 0.5 mg. cobra venom in 10 c.cm. buffer of pH 8.4.                                  | 0.27                           |
| 3. 100 mg. casein + 0.5 mg. cobra venom in 10 c.cm. buffer of pH 8.4.                       | <i>nil</i>                     |

The next possibility of the mechanism of this *in vivo* increase of plasma trypsin is the increased capacity of the red blood corpuscles, leucocytes or platelets which are the chief sources of trypsin in blood, to synthesize the enzyme. Determination of the trypsin content of red corpuscles and the mixture of leucocytes and platelets made before and after the injection do not show any significant difference.

In the light of the above results, the only reasonable explanation that can be offered for the observed increase is that the proteolytic enzyme is released into the blood from the tissues under the influence of the venom. This tentative hypothesis could not be put to test.

By an examination of table II, it can be seen that the plasma trypsin content which has a progressive tendency to rise until a dose of 0.12 mg./kilo of cobra venom is reached, falls down suddenly when the amount of venom is increased to 0.15 mg./kilo. If the dose is further increased, the fall in the plasma trypsin content is much more significant. The presence of trypsin-inhibitor in the cobra venom (Ghosh, 1936, and Iyengar *et al.*, 1938) might be responsible for this strange finding. This inhibitor is present in such small quantity that it cannot effectively exert its action until sufficient concentration of the venom is obtained. When a dose of 0.15 mg./kilo is reached, the inhibitor probably begins to exert its effect and inactivates the trypsin that is released from the tissues. The inactivation of the normal plasma trypsin is also noticed when the amount of the venom injected is further increased to 0.19 mg./kilo. In this case the plasma trypsin content (17.3 mg.) is lower than the normal value (25.3 mg.).

The *in vivo* action of an analogue of vitamin K (2-methyl-1:4 naphthaquinone) was next investigated and the results are given below. Since the substance was injected in an oil medium, the time allowed for complete absorption was six hours. In some cases, the blood was taken even after 24 hours for trypsin determination. It is reported that prothrombin increase can be noticed 6 hours after the injection of vitamin K, although a significant rise can be observed only at the end of 12 to 24 hours.



There does not seem to be any change in the plasma trypsin activity, either free or combined, on the administration of 2-methyl-1:4 naphthaquinone, a synthetic analogue of vitamin K.

TABLE IV

*Dog weighing 7 kilos.*

| Amount injected | ACTION OF 2-METHYL-1:4 NAPHTHAQUINONE ON PLASMA TRYPSIN |  |
|-----------------|---|--|
|                 | Free plasma trypsin<br>6 hours after injection          | Total trypsin<br>6 hours after injection |
| <i>nil</i>      | 23.5 mg.  | 62.6                                     |
| 1 mg.           | 22.8 "  | 68.5                                     |
| 2 "             | 18.5 "  | 64.2                                     |
| 3 "             | 24.6 "  | 61.9                                     |
| 4 "             | 17.9 "  | 67.2                                     |
| 5 "             | 14.8 "  | 68.4                                     |
|                 | 18 hours after injection                                | 18 hours after injection                 |
|                 |   |  |
| 3 mg.           | 14.5 mg.  | 65.6                                     |
| 4 "             | 18.2 "  | 62.8                                     |
| 5 "             | 16.8 "  | 67.9                                     |

Trypsin, however, is not known to be influenced by mild oxidizing or reducing agents while cathepsin is known to be definitely affected by the oxidation-reduction state of the medium. It is, therefore, reasonable to expect changes in the catheptic activity of serum under the influence of this drug.

TABLE V

*Action of 2-methyl-1:4 naphthaquinone on serum cathepsin*

| Amount injected | Serum cathepsin<br>(6 hours after injection) | Amount injected | Serum cathepsin<br>(6 hours after injection) |
|-----------------|--|-----------------|--|
| <i>nil</i>      | 42.6 mg.                                     | 3 mg.           | 28.2 mg.                                     |
| 1 mg.           | 41.2 "                                       | 4 "             | 29.5 "                                       |
| 2 "             | 36.5 "                                       | 5 "             | 30.8 "                                       |

There is a significant reduction in the catheptic activity of the serum after the injection of the drug. This inhibitory effect must be due to change in the oxidation-reduction state of the medium brought about by the anti-hæmorrhagic substance. This substance is a reversible oxidation-reduction catalyst, the hydroquinone form of which is readily oxidized by molecular oxygen. This action of inhibiting the catheptic proteolysis by 2-methyl-1:4 naphthaquinone may be regarded as favouring protein synthesis since normal anabolism and catabolism of proteins tend towards equilibrium. The net

effect of inhibiting proteolysis must be to favour protein synthesis in the system. This action of vitamin K will therefore serve as a link to explain the mechanism of its action of increasing prothrombin protein as visualized by McCawley and Gurchot (1940).

#### Summary

The action of cobra venom on the tryptic activity of plasma has been studied. It has been found that up to a dose of 0.12 mg./kilo, there is a remarkable increase in the trypsin content of plasma and it begins to go down if the dose is increased beyond this limit. The various possibilities regarding this increase have been investigated and it is suggested that the venom may be releasing into the blood stream trypsin from the tissues. It is interesting to recall that Iyengar *et al.* (1942) have reported that plasma trypsin is reduced considerably in cases of malignant growth and that Chopra and Chowhan (1935) have recommended the administration of cobra venom solutions in the therapy of cancer. The finding in the present investigation that the plasma trypsin is increased by the administration of the cobra venom may therefore be useful partially to explain the rationale of the treatment of cancer by cobra venom. The decrease in plasma trypsin brought about by larger doses of the venom is explained as due to the trypsin inhibitor reported to be present in the venom. This inhibitor effectively comes into action only when the venom is administered in larger doses not encountered in clinical practice. 2-methyl-1:4 naphthaquinone does not exert any action on the plasma trypsin, but appears to inhibit the catheptic activity of serum. It is suggested that this action of the drug may serve to explain the mechanism of the action of vitamin K in synthesizing prothrombin.

#### Acknowledgments

Our thanks are due to Sir R. N. Chopra for his keen interest in this investigation, and for the help rendered in certain parts of the experimental work to Mr. K. B. Selra.

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## A SHORT NOTE ON THE METHODS OF WATER-PROOFING CALICO OR OTHER COTTON FABRICS

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As a result of the shortage of rubber owing to war conditions, great difficulty is being experienced in obtaining water-proof fabrics, *e.g.*, coverings for first-aid dressings, military dressings, etc. These coverings are generally made of water-proof sheeting largely of a rubber basis but this is now difficult, if not impossible, to obtain and hence it was thought desirable to discover some simple and cheap methods of water-proofing calico or other cloth fabrics from materials readily available in India.

The following are the more important methods of rendering cloths water-proof :—

### *General methods*

(1) By imbibition of fatty, oily or tarry substances (oiled or tarred fabrics), or the like.

(2) By immersion in a suitable bath leading, after special treatment, to the formation of insoluble compounds of the elements composing the material, the latter being thus rendered water-proof or impermeable.

(3) By coating one or both sides of the material with a layer of rubber or by uniting two fabrics by means of a layer of rubber—the most commonly used method for preparing water-proof material.

(4) By covering one or both sides with a layer of pasty material which is capable of drying rapidly and is based on waxy or paraffin materials or drying oils; the most diverse mixtures of these substances with rubber, resin, castor oil, gypsum, barium sulphate, koalin, talc, ferric oxide, lamp black, etc., are also used.

(5) By covering one or both sides of a material with a more-or-less thick uniform layer of nitrocellulose and camphor mixed sometimes with castor oil and with coal tar colouring matters or substances which give it an opaque appearance, such as zinc oxide, mineral white, etc.

### *Special methods*

(6) *Lowry's process*.—Two ounces soap, 4 ounces glue, 1 gallon water. Soften the glue in cold water, and dissolve it together with the soap in the water by aid of heat and agitation. The cloth is filled with this solution by boiling it in the liquid for several hours, the time required depending upon the kind of fibre and the thickness of the cloth. When properly saturated, the excess of liquid is wrung out, the cloth is exposed to the air until nearly dry, then digest for 5 to 12 hours in the following solution: 13 ounces alum, 15 ounces salt, 1 gallon water. It is finally wrung out, rinsed in clean

water, and dried at a temperature of about 80°F. (27°C.).

(7) *Berlin water-proof cloth* is prepared by saturating the cloth in a solution of aluminium and copper acetate, then dipping it successively in water glass and resin soap.

(8) *Belgian war method*.—The materials to be water-proofed are soaked in a solution of aluminium acetate and then withdrawn without being wrung, and dried in the air.

(9) Apply boiled linseed oil with a little litharge in it (5 per cent) on the calico or other fabric and allow to dry. Give 3 or 4 coats. Each coat should be allowed to dry before the next is put on.

(9a) Dissolve some good resin or lac over the fire in drying linseed oil, till the resin is dissolved and the oil brought to a thickness of a balsam. Spread this upon the cloth so as fully to drench and entirely to glaze it over and then allow to dry thoroughly.

(10) *Wax-cloth or paraffin cloth*.—The superiority of paraffin over most other materials for some kinds of water-proofing consists in its comparative cheapness, in being easily applied and in not materially altering the colour of fabrics. The method of water-proofing with wax or paraffin is too well known to merit description. The chief drawback of the method is that fabrics water-proofed by this method do not stand autoclaving.

Methods (3), (4) and (5) are most widely used but as the essential raw materials for these methods (rubber, nitrocellulose, etc.) are not now available, they may be ruled out. Methods (2), (6), (7), (8), (9) and (9a) were specially investigated by us as we were particularly interested in products that would not only be water-proof but would also stand sterilization in an autoclave. Method (6) was found to be unsatisfactory. Calico or other cotton fabrics can be conveniently water-proofed by the following simple methods :—

(1) Boil for about ten minutes (with stirring) double-boiled linseed oil (available in the market), 100 parts, with 5 parts of shellac and filter through cloth. Apply the filtrate carefully with a brush on the calico or other cloth to be water-proofed and allow the treated fabric to dry in the sun. When dry, give a second coating with the treated linseed oil and again allow to dry in the sun.

(2) Dip the fabric in a saturated solution of aluminium acetate (which for practical purposes can be conveniently prepared by mixing a 30 per cent alum solution and 30 per cent lead acetate solution and filtering) and allow the fabric to remain in the solution (completely immersed) for about 24 hours. Heat the treated fabric in a steam chamber for about 3 hours or allow it to remain in the aluminium acetate bath for a further period of 2 hours and keep the aluminium acetate solution boiling during these two hours. Allow the fabric to dry in the air and then keep it immersed in a hot solution

(80° to 90°C.) of soap (8 per cent) and glue or gum (2 per cent) for about one hour. Take out the fabric, rinse it with a little water (to remove excess of soap and glue) and dry in a drying chamber and finally calender it.

Calico or other cotton fabrics rendered water-proof by any of the above two methods can be sterilized without any detriment to their water-proofing properties. Cloth treated by method (1) is completely water-proof, while water-proof cloth prepared by method (2) has an *excellent appearance* although this method requires careful scientific supervision (e.g., of the pH value of the aluminium acetate solution, etc.).

In European countries it is not now considered necessary that coverings for military dressings

should be impervious to both air and water. The modern methods aim at producing cloth which is water repellent and yet allows comparatively free passage of air. The modern tendency in water-proofing is to treat fabrics with organic compounds which decompose on heating and leave an insoluble, water-proofing film on the fabrics. Among such compounds, velan and quaternary ammonium salts containing a long paraffin chain attached to a polar group which is unsaturated, or which becomes unsaturated by ionization on heating, have been receiving much attention recently. But for the present, these newer methods have to be ruled out for practical purposes as the starting substances are not readily available in India.

## A Mirror of Hospital Practice

### TETRACHLORETHYLENE AS AN ANTHELMINTIC FOR TAPEWORM

By P. C. DUTT, L.M.F.

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MALE fern has been commonly used for many years as an anthelmintic against cestodes, though its administration is very troublesome and even risky to the host.

Maplestone and Mukerji (1931) mention trying of tetrachlorethylene in three cases of *Tænia saginata* infection with apparently no effect. But their further experience with tetrachlorethylene (Maplestone and Mukerji, 1937) claim the drug as an effective remedy in treating *tænia* infections.

Considering the advantages of tetrachlorethylene over *Filix mas* in respect to its simplicity of administration and very little toxicity we also tried it in three cases of tapeworms with encouraging results, which are briefly summarized as follows :—

### Conclusion

(i) The treatment in three cases of tapeworm infection with tetrachlorethylene has been noted.

(ii) It is very cheap, easy to administer, fairly efficient and safe, and seems worthy of trial in preference to male fern.

My thanks are due to my chief Dr. J. A. Lewis, medical officer, for his encouragement and kind permission to publish the report.

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### A CARBUNCLE TREATED WITH HEAT AND CHEMOTHERAPY

By M. L. DIDI, L.S.M.F.

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ONE, Balia, aged 47 years, resident of a village in this State attended the out-patient department of the hospital for the treatment of an abscess on the back

| Case                    | Treatment  | Toxicity  | Result  |
|-------------------------|--|---|---|
| (1) Female, 34 years    | (i) Tetrachlorethylene .. dr. 1<br>Saturated solution of magnesium sulphate .. oz. 1<br>Mixed well after shaking in a phial and given on empty stomach in the morning.<br>(ii) Followed two hours later by saturated solution of magnesium sulphate .. oz. 1 | Nil   | Successful. (Report after eight months shows no recurrence of the worm. Stool—no tapeworm ova.) |
| (2) Male, 35 years      | Do.  | Nausea, warmth in the epigastrium. Slight nausea. | Do.   |
| (3) Male child, 7 years | (i) Tetrachlorethylene .. m 25<br>Saturated solution of magnesium sulphate .. dr. 4<br>Mixed well after shaking in a phial and given on empty stomach in the morning.<br>(ii) Followed two hours later by saturated solution of magnesium sulphate .. dr. 6  |   | Successful. (Treated recently.)   |

of neck early this month, *i.e.*, May 1942. On examination a big carbuncle was noticed on the back of his neck with several openings discharging pus. The patient was experiencing agonizing pain with no relief in any position. Duration one month.

The patient was admitted to the ward. His urine was examined and found sugar-free.

**Treatment.**—Operation was considered necessary, but as these hill-men are of very hasty nature and do not like to stay in the hospital very long it was avoided and palliative measures were tried. Finely powdered sulphonamide tablet (Boots) was introduced in the interior of the carbuncle through its various openings and hot kaoline plaster was applied over it. Solu-septasine (M.&B.) 10 c.cm. was injected intramuscularly and proseptasine (M.&B.) four tablets a day was prescribed; this is less than the ordinary recommended dose owing to shortage of stock. The effect of all this was that the patient passed a relatively restful night, but next day again he complained of severe pain as before and insisted on going home back in despair. He was dissuaded from leaving the hospital with great difficulty and was given another soluseptasine injection, only 5 c.cm. being given this time *plus* oral and local treatment as before except that the local treatment was repeated twice a day. Next day, *i.e.*, on the third day of treatment, there was noticed much improvement in his condition and by following up the treatment, except injections, for another two days the whole thing was reduced to discharge as he was feeling cured. However, he was detained for three days more and the same treatment was continued, and at the end of this period (total of one week) he was almost cured, his carbuncle having been reduced to what appeared only a big weal. He was discharged from the hospital in this condition and after a week of his discharge he was quite all right.

## MENINGITIS—SIX CASE REPORTS

By N. A. AIENGAR, L.R.C.P., M.R.C.S.  
S. T. PARTHASARATHY, M.B., B.S.  
S. GUNDU RAO

and  
K. RAMSHASTRY

(From the Sri Chamarajendra Hospital, Hassan)

THE ætiology of six cases of meningitis has been investigated in this hospital and the observations are being continued. For lack of facilities, cultural examinations have not been done. All the same, the diagnosis has been arrived at and the ætiology has been decisive in almost all the cases.

**Case 1.**—Female, aged 22 years, previous history of malaria and cachexia—had been treated in this hospital.

The patient came with a history of fever for 15 days. Admitted in a semi-comatose state with delirium. Fever continuous, ranging between 100°F. and 102°F. Pupils equal on both sides, reacting to light. Facial paresis on the left side. Kernig's sign doubtful; no exaggeration of reflexes; superficial reflexes preserved; response to pain present; incontinence of urine and motion. There were no lung signs. Heart—weakness of the myocardium. Urine—nothing abnormal. Blood smear—malarial parasite not found on repeated examination; differential leucocyte count; polymorphonuclears—60 per cent; lymphocytes—35 per cent; eosinophils—4 per cent; large mononuclears—1 per cent. Total leucocyte count—15,000 per c.mm. of blood. Lumbar puncture—cerebro-spinal fluid under moderate pressure (pressure not measured). Cell count—20 per c.mm. of fluid. Cells—lymphocytes predominating in the fields; polymorphonuclears also present conspicuously.

Organisms—non-motile, Gram-negative bacilli definitely present.

**Diagnosis** of meningo-encephalitis was made. **Treatment.**—M.&B. 693 soluble 3 c.cm. was given intramuscularly every day, as also prontosil rubrum soluble 5 c.cm. M.&B. 693, 2 tablets twice a day, was given as long as the patient was able to take it, *i.e.*, till the sixth day. The temperature continued unabated.

On the fourth day the patient was more conscious. On the sixth day the patient developed progressive bulbar paralysis and died on the seventh day after admission.

**Case 2.**—Boy, aged 10 years. Fever for three days. Unconscious and delirious. Kernig's sign positive. Retraction of the head positive. Blood—malarial parasites not found. Polymorphonuclear leucocytes—90 per cent; lymphocytes—10 per cent. Total leucocyte count—25,000 per c.mm. Lumbar puncture—fluid under pressure; highly turbid, almost milky white in appearance. Cell count—500 per c.mm. Organisms—non-motile; Gram-positive diplococci (pneumococci) found in plenty. Cells mostly polymorphonuclear leucocytes.

The patient was put on M.&B. 693 by mouth, 2 tablets once in 4 hours. Fever continued unabated and the patient died on the second day after admission.

**Case 3.**—Male, aged 25 years, was an in-patient in the ward with influenza broncho-pneumonia. On the 12th day of fever patient had a higher temperature (103°F.) and became delirious. Mild retraction of the head and positive Kernig's sign. Blood—malarial parasites not found. Polymorphonuclears—80 per cent; lymphocytes—20 per cent. Sputum—pneumococci not present. Lumbar puncture—cerebro-spinal fluid under high pressure; almost purulent in appearance. Cell count—500 per c.mm. Organisms—non-motile, Gram-negative bacilli found. Cells—polymorphonuclears predominant.

The patient died 3 days later; he had been put on sulphonamide 2 tablets thrice daily and urea sulphazide, 5 c.cm. intramuscularly daily.

**Case 4.**—Boy, aged 12 years, was being treated in the ward for influenza broncho-pneumonia. On the 10th day of fever, the patient developed signs of mild meningitis. Blood—malarial parasites not found. Polymorphonuclears—80 per cent; lymphocytes—20 per cent. Total leucocyte count—20,000 per c.mm. Lumbar puncture—cerebro-spinal fluid under high pressure. Cell count—30 per c.mm.; polymorphonuclear cells. Organisms—non-motile, Gram-negative bacilli found.

The patient improved after two lumbar punctures and he made an uneventful recovery. Sulphonamide tablets, 2 thrice daily and urea sulphazide, 5 c.cm. a day intramuscularly were given for 5 days.

**Case 5.**—Male, aged 40 years. Diagnosis—lobar pneumonia. Admitted on the fifth day of fever, delirious. Blood—total leucocyte count—25,000 per c.mm.

On the sixth day of fever he showed definite signs of meningitis. Lumbar puncture—fluid under pressure, deep straw-coloured and markedly hazy. Cell count—300 per c.mm. Organisms—pneumococci found in plenty. Cells—polymorphonuclears only.

The case ended fatally on the seventh day of fever, in spite of M.&B. 693, which was given orally 2 tablets once in 4 hours.

**Case 6.**—Female, aged 22 years. Admitted to the hospital with a history of fever for three days and was sent as a case of cerebral malaria. Patient delirious, semi-comatose with 102°F. temperature. Blood—malarial parasites not found. Leucocytes: Total leucocyte count—20,000 per c.mm. There were mild signs of meningitis. Lumbar puncture—fluid under high pressure, hazy. Cell count—50 per c.mm. Organisms—pneumococci found. Cells—polymorphonuclears.

Patient recovered completely after treatment with M.&B. 693 orally and by injection; in all three injections of M.&B. 693 soluble were given and 2 tablets three times a day were given for four days.

**Discussion.**—Cases of meningitis were reported in the *Lancet* of December 1941, in which the causative organism was shown to be Pfeiffer's bacillus (influenza). With a view to find out the exact cause of meningitis or meningitic signs and symptoms occurring as a complication in cases of pneumonia of all types, a series of lumbar punctures were done. The first series of six cases have been reported here and the observations are still continuing. The first case did not show any lung signs till the sixth day when mild bronchitis was noticed on the right base. This case showed all the signs of meningo-encephalitis. The causative organism in this case and also in cases 3 and 4 was, as far as could be seen, Pfeiffer's bacillus. The other three were cases of lobar pneumonia and developed pneumococcal meningitis as has been reported here. These six cases occurred fairly concurrently and we have had two more cases after them. These two were also lobar pneumonia cases. They developed mild signs of meningitis, or probably meningism on the seventh day of fever and responded well to lumbar punctures and large doses of M.&B. 693. Though the cerebro-spinal fluid in these two cases was under moderate pressure, yet, there was no increase in cellular content and no organisms were found.

## URTICARIA DUE TO MALARIAL INFECTION

By P. C. SEN GUPTA, M.B. (Cal.)

(From the School of Tropical Medicine, Calcutta).

ALLERGIC reaction in man as a result of malarial attacks is an exceedingly rare occurrence and available literature shows very few references to such an event. Zallocco (1928) reported a case of a child in whom asthmatic paroxysm accompanied malarial attacks and Thonnard-Neumann (1928) described cases in Haiti where treatment of malaria cured co-existent asthma. Castellani and Chalmers (1919) regard urticaria as a manifestation of hypersensitiveness to the malarial parasite as extremely rare. In recent years, cases showing urticaria as a result of hypersensitiveness to malarial parasites have been reported by Eyermann and Strauss (1930), Davies (1936), Gouriou (1938) and Agrama (1940) in Africa and Europe and by Chatterjee (1939) in India, who reported three cases.

The case reported below was encountered at the Kaorapukur treatment centre, of the Calcutta School of Tropical Medicine. The Kaorapukur centre is situated in the heart of a highly-endemic malarial area about 5 miles from the outskirts of Calcutta. Here about 60 per cent of the total cases treated are malarial subjects and during the malaria season, i.e., end of

September to the first half of January; about 80 to 90 per cent of the total attendance is formed by malaria cases.

### Case note

J. B. D., Bengalee female, aged 18 years, attended the out-patient clinic on the 29th April, 1942, for recurring attacks of fever. This year the patient had the first attack of fever a month previously. The fever came on with chill and rigor and with it there were severe urticarial eruptions all over the body and the patient had fits of unconsciousness. The temperature came down somewhat next morning, but it went up again on the following days with chill and rigor and the urticaria persisted. The patient was treated with cinchona alkaloids and she became afebrile after about a week's illness. The next attack of fever (about a fortnight previous to the date of attendance) was similar to the previous one, and lasted about a week, finally coming down with treatment.

The patient was at the clinic at the onset of fever on the 29th April. She had chill and rigor and vomiting, started scratching her body, and soon developed an urticarial rash all over her body. She had a fainting attack too, this however was very short-lived. Her spleen was palpable. Blood was taken immediately and examined for the presence of malarial parasites. *Plasmodium falciparum* ring forms, *Plasmodium vivax* ring forms, growing trophozoites and schizonts were found and the infection was quite heavy. The patient was given an injection of adrenaline hydrochloride m.v. hypodermically to relieve her urticaria for the time being and was given quinine sulphate gr. x in a mixture immediately and advised to continue the mixture twice daily for a week. The fever and the urticaria subsided next day. The attacks of fever were stopped completely in the course of the next three or four days, and she was afebrile and free from urticaria when seen a week later. Quinine was continued for one week more and then the patient was put on a tonic mixture containing iron and arsenic.

In this case each malarial paroxysm was associated with an attack of urticaria and with the subsidence of malaria urticaria disappeared. It seems that in this case, the patient was hypersensitive to the malarial parasites and the liberation of numerous merozoites at the onset of malarial paroxysm gave rise to this manifestation of allergy, viz, urticaria. It was apparently not due to quinine, which really cured the urticaria along with malaria.

### Summary

A case where every paroxysm of malarial fever was accompanied by urticaria is reported. This is probably an instance of a very rare condition—hypersensitiveness to malarial parasites, producing urticaria.

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# Indian Medical Gazette

JULY

## SHOCK

A POPULAR criticism of the medical profession is that we are often so interested in obscure diseases that we are inclined to ignore economically important conditions such as the common cold. There is not so much justification for this criticism to-day as there was, say, before the 1914-18 war when the profession as a whole was less public-health minded than it is to-day. Further this weakness is a natural one; there are two interdependent qualifications that will raise the maximum medical interest in any disease, namely, that it should be (i) a serious and often fatal condition and (ii) preventible and/or curable. It is very difficult to sustain any interest in a disease that is invariably fatal, until some ray of hope appears on the horizon; similarly, we are a little inclined to be bored by other diseases, individually benign, with none the less a high nuisance value and equally incurable, as is the common cold, especially as the practitioner is always expected to produce some infallible cure which must be quite different from that of any other doctor whom the patient has consulted before (because their specifics so often successful at first, as the common cold is a self-limiting disease, have in the long run of course always failed).

Now shock possesses both these qualifications; untreated it is a very serious and often fatal condition, and adequately counteracted it is, one can almost say, a hundred per cent preventible and even when well established almost as certainly curable. It has therefore attracted a very great deal of medical attention during the last few years, especially since circumstances have made it a very common incident, and a distinct advance in our knowledge of the subject has been achieved.

What exactly is shock? Though this is a question that cannot be answered with absolute certainty, there is to-day a fair degree of unanimity of opinion that shock is brought about simply by *loss of plasma from the circulation*, with the other elements of the blood in hæmorrhage, from the surface in the case of a burn, and into the damaged tissues in the case of other forms of injury.

By way of experimental proof of this fact, it has been shown that if an animal is bled repeatedly, the red cells separated from the plasma, and the former returned into the animal's circulation that animal will die even more rapidly than will a similarly-bled animal in which the red cells are not returned. Next, it has been shown that if an animal is subjected to trauma of one limb to the extent of causing shock and then the animal is killed and its two limbs weighed, the increase in weight of the

traumatized limb corresponds to the loss of plasma from the circulation, and that this increase in weight of the limb is due to exudation of plasma into the tissues. Finally, it has been shown that if plasma is given to an experimentally burnt or traumatized animal, in sufficient amount and quickly enough, shock can be obviated.

Shock is thus reduced to very simple terms. Is its treatment as simple? One can say that given suitable facilities it is. The first step is of course to remove the cause, to stop the hæmorrhage or the surface exudation if this is possible; the second is to replace the loss from the circulation. How should this loss be replaced? This will depend on the nature of the loss, namely, whether it was plasma or whole blood. If the loss was whole blood it is usually advantageous, but not necessarily so, to replace it by blood; if the loss was plasma it will certainly be better to replace it by plasma or a plasma substitute rather than by whole blood, but again in most circumstances whole blood will be better than nothing. In neither case will replacement by isotonic saline, glucose, or any other crystalloid solution be of the slightest use for shock proper, as they only remain in the circulation for a very short time and produce only a very temporary rise of blood pressure, though they may be of value to combat dehydration, a very common accompaniment of shock.

The only satisfactory substitute for plasma is serum, and for practical purposes, in the matter of ease of preparation and storage, this has certain distinct advantages over plasma. Another, though infinitely less satisfactory substitute, is gum-saline solution. Experiments are being carried out in different parts of the world to find some really satisfactory transfusate that is not human in origin, whole animal blood, plasma or serum cannot be used on account of the anaphylactic effects that it produces, but as most of the specific substances are associated with the globulin fraction it is believed that it may be possible to prepare an albumin fraction from bovine or sheep's blood that it will be possible to use in the place of human plasma. However this substitute has not yet been perfected and meanwhile we must rely on human sources alone.

The plasma loss in a case of severe shock is very considerable and may amount to half the total plasma volume, that is  $2\frac{1}{2}$  pints in an average man, and when it is associated with blood loss the total fluid loss from the circulation may amount to 4 or even 5 pints. It may not be necessary, and it will usually not be advisable, to replace this whole loss, but in a severe case of shock it is seldom worth while giving less than 2 pints, but one is naturally influenced in the individual case by the patient's reaction to the transfusion, and the blood pressure is the best guide. An average good blood donation is a pint; from this very little more



than one-third the amount of plasma or serum is obtainable, so that for a good transfusion at least six blood donations are necessary. This gives some idea of the difficulty of providing sufficient material for blood transfusions that are necessary in the battlefield and in towns during air raids, and emphasizes the urgent necessity for the establishment of proper organizations for obtaining blood from volunteers and the necessity for all healthy persons volunteering when such organizations are established.

Shock is a very fatal condition but it is also curable; the material with which it can be cured is plentiful—every healthy man or woman can easily spare one-tenth of his or her blood per month without detriment to health. It only needs an organization and a very little personal sacrifice to ensure that sufficient of this life-saving material is ready for any emergency. Save, therefore, in exceptional circumstances it is a very grave reflexion on the community when anyone is allowed to die of shock for lack of a blood or plasma transfusion.

#### NEW EMERGENCY COMMISSIONS FOR SERVICE IN INDIA ONLY

ATTENTION is drawn to this new scheme, further details of which will be found on page 424.

There has been a somewhat surprising hesitancy on the part of the younger members of the medical profession in India to volunteer for service in the present emergency. Political opinions have been used rather as an excuse than a reason to this hesitancy, for no one will deny India's danger or the necessity to defend her shores and frontiers, and if these facts are accepted it is sheer inhumanity to deny her

soldiers proper medical care. The claim that India was being defended in Lybia and at Singapore—which was in some quarters stigmatized as a recruiting trick—is we now know only too true, as the failure to defend our eastern outpost adequately has brought the enemy to our very gates.

There are however many young Indians who have a genuine deep-rooted, not to say a religious, prejudice against leaving their native soil, and the terms of these new emergency commissions will meet this objection; those who take up these commissions will not be asked to leave India. Otherwise, the terms of service are almost identical with those of the temporary and short-service commissions; the basic pay is from Rs. 300 per month to Rs. 550 at the end of six years, there are extra allowances for specialists, liberal charge pay, and generous terms for antedating so that experienced medical men may start well up or even at the top of the grade.

We are sure that there are a very large number of medical men who would genuinely like to be serving their country, and who themselves do not entertain any prejudices but are deterred from volunteering by family opinion. It is not unnatural that parents and wives should be anxious for the safety of their children and husbands but, they are often ashamed to voice these personal fears in the face of the national danger which they cannot deny, and they consequently translate their objections into terms of politics and religion. The young medical man now has an answer to these objections. We believe that very large numbers will apply for these commissions and we strongly recommend those who are proposing to apply to put in their applications immediately.

## Special Article

### A NOTE ON THE WORK OF DR. P. L. SIMOND ON THE TRANSMISSION AND EPIDEMIOLOGY OF PLAGUE

By J. LOWE, M.D.

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RECENTLY the author had occasion to prepare a post-graduate lecture on plague, and in doing so read the chapters on plague in several standard textbooks of medicine. In these chapters the portions relating to the early researches on plague at the end of the 19th century and the beginning of the 20th century appeared rather unsatisfactory, and therefore a study was made of the original publications. This study made more clear the unsatisfactory nature of the published account of the work of the period. In particular there was little or no appreciation of the work of a Dr. Simond in

Bombay in 1898 and of a very able article published by him in the *Annales de l'Institut Pasteur* (1898, pp. 625-687) in which many of the now-accepted facts and theories about the epidemiology and transmission of plague were enunciated apparently for the first time.

For a few years after their publication the views of Simond were strongly criticized and even ridiculed, and, later, when the truth of most of Simond's views became apparent, his work appears to have been forgotten, and other people generally credited with the enunciation of the now-generally-accepted theories concerning the epidemiology, spread and transmission of plague. It therefore seems desirable that in the country in which Simond worked and wrote and in the journal which ridiculed his ideas, there should be some acknowledgment of the fact that his contribution to the study of the epidemiology and transmission of plague was

probably greater than that of any other single worker.

The present author does not even know who Dr. Simond was. From his name and from the fact that he wrote in French and published in French journals one surmises that he was of French nationality. In 1894 Simond had made a report to the sanitary authority in French Indo-China (where he was apparently on a mission) of the occurrence of plague in Tonkin. In 1895 this report was published in the *Archives de Médecine Navale*. In what circumstances he came to work and write in Bombay in 1898 is unknown. He apparently published only two articles on plague, but the second of these was of such outstanding merit as to establish him as one of the great workers in tropical medicine.

In order to assess the value of the work of Simond, it is necessary to remind ourselves of what was the state of knowledge of plague at the time that Simond worked and wrote, and shortly afterwards.

As Greenwood has well said, plague is perhaps the best example of the beliefs of unlearned people containing more essential truth and practical wisdom than the opinions of wise and learned men. In all countries of the world where plague was common in ancient times, the fact had been noted that rats began to die before an epidemic of plague occurred amongst human beings. References to this fact are contained in ancient literature of many countries, and the idea is expressed that dying rats had an important connection with human plague. When the last great pandemic started in 1894 and the causative organism was discovered by Yersin, the danger of the spread of plague to many countries was soon realized, and various countries appointed commissions to study the spread and prevention of plague. There was an English Commission in India in 1898-99, a German Commission, an Austrian Commission, a Russian Commission and an Egyptian Commission, and possibly others. These commissions failed to realize the true connection between rat plague and human plague, and they regarded the disease as being conveyed chiefly from person to person. The Indian Plague Commission in 1899 even stated 'there is absolutely no evidence that the disease has ever been carried from one country to another by plague-infected rats in ships'. Even several years later than 1899 the idea was being expressed that rats were commonly infected from human beings and that other rats got the disease by eating dead plague-rats. The idea was also commonly expressed that the disease was a soil infection which could be acquired by man and rats. The main anti-plague measures recommended by the various commissions at that time were the early detection and isolation of plague cases and the disinfection of houses, of articles and clothing by spraying with anti-septics. Both these measures are of very

doubtful or limited utility and it is not surprising that plague continued to flourish.

The idea of plague being primarily a disease of rats was first expressed by Yersin and Roux in 1897 (*Acad. Med.*, 1897, p. 93) and the idea that the disease might be conveyed from rats to human beings by fleas was apparently first expressed very tentatively by Ogata in 1897 (*Centralbl. f. Bakt.*, Vol. XXI, p. 774). Ogata noticed that rats handled immediately after death were dangerous and also flea-infested, but that rats handled some time after death were not flea-infested and were not dangerous. He transmitted plague to healthy rats by the injection of emulsion of fleas from a plague-rat.

This was the state of knowledge in 1898 when Simond wrote his article. It is doubtful whether Simond had any knowledge of Ogata's suggestion regarding the fleas. He makes no reference to it in his article which was published very shortly afterwards, and it appears probable that Simond's ideas were entirely original.

As already stated the article by Simond was published in the October 1898 number of the *Annales de l'Institut Pasteur*, Paris, and was signed by him in Bombay in August. The work was, therefore, probably done at least several months before this date. In this article, which runs to 62 pages, Simond gives an exhaustive and well-documented account of the history and epidemiology of plague in the world as a whole and in India in particular up to that date, with particular reference to the pandemic of plague which he describes as beginning in 1893 in China, the arrival of which in French Indo-China he had reported in 1894. He interprets this history as pointing to the rat as the main reservoir of the disease and the main source of infection to man.

He then goes on to describe his own personal observations and experimentation on the epidemiology and transmission of plague and he advances many views about plague which were completely new at that time, but which have been amply confirmed by later experience.

He stated for instance that the introduction of plague-rats into a healthy area was generally followed by an epidemic of plague in man, but that the introduction of an infected man into a healthy area was often not followed by an epidemic. He found that the epizootic preceded the epidemic, that it was usually localized in one area of a town to begin with, and that human plague later started in that area. He considered that the rat was a much more important agent of transmission of plague than man. He recorded the incidence of plague, month by month, in Bombay and elsewhere and noted that plague epidemics were at the height in the cold season and attributed this to factors connected with the rat. He carried out extensive feeding experiments in rats, and proved that rats were not usually infected by eating the infected tissues of other dead rats, by showing that in order to transmit the disease in this

way, enormous numbers of bacilli had to be ingested and that the disease so produced varied markedly from that seen in nature.

He noticed that in about 5 per cent of human cases a primary lesion in the form of a blister containing plague bacilli was seen, and recorded the site in the body of many of these blisters and found that they were most common on the foot and leg. He considered that the blister was probably at the site of the bite of the transmitting insect.

He then went on to study the parasites of the rat. He found that a plague-rat free from parasites could not transmit the disease to healthy rats kept in the same cage but that a plague-rat infested with parasites could and usually did transmit the disease to healthy rats. He studied the parasites of the rat, the flea and the louse, and he found that these, particularly the flea, contained numerous ingested plague bacilli in their intestinal tract. He crushed infested fleas and injected the material into rats and produced the disease. He therefore considered that the mode of transmission of plague was from rat to rat and rat to man by an infested parasite, most probably the flea. He studied the behaviour of fleas on rats dying of plague. He reported that on death of the rat the fleas detach themselves from the rat's body but remain for a time in the fur, and quickly attach themselves to any animal or man coming in contact with the dead rat. If no such contact occurred they left the dead rat in search of another host. He studied the actual mechanism of transmission. He found that infested fleas while feeding passed plague bacilli in their excreta and considered that the infection might be introduced at the time of the bite and into the proventricular valve with regurgitation of infected blood in attempts to feed, which was actually not recorded until sixteen years later by Bacot and Martin (*Journal of Hygiene*, January 1914, *Plague Supplement*, p. 423).

He noted many other points about plague. He found that fleas may remain infected for a considerable period and suggested that this fact might help to explain the carrying of plague from one season to another. He found that in cities where plague had been present, rats showed a relatively high degree of immunity to plague. He also suggested that variations in the rat population and in their susceptibility to plague played an important part in causing the periodicity of plague. He ascribed the decline and disappearance of the infection in an area to the death of a large part of the rat population, immunity of the remaining rats, and thought that re-population of the area by new strains of susceptible rats might cause recrudescence. He also believed that plague might continue to linger among rats in a benign form in the period

following an epidemic and that sporadic cases in man might thus be explained.

Simond attributed the immunity of laboratory workers to plague to the fact that while wild rats usually had numerous fleas, laboratory rats usually had not. He noted the rarity of plague among the staff of plague hospitals and attributed this to the absence of rats and fleas in the hospitals.

Perhaps the most surprising thing is the fact that he used the mouse-protection test as a measure of the efficacy of anti-plague serum and in his article he gives the result of his work on this subject. He also recorded that the bacilli in cultures gradually lost their pathogenicity, and that for certain experimental transmission, best material. He showed that anti-plague serum (which he obtained from Paris) could usually protect a mouse against infection with bacilli from a culture, but usually did not protect a mouse against infection with fresh virulent material.

He stated that the prophylaxis of plague must be based on the destruction of rats and also of their parasites and on the prevention of the access of rats to human habitations by proper construction or reconstruction. He stated that the conveyance of plague from one country to another on ships could be prevented by the destruction of not merely the rats but of the rats' parasites in ships and advocated the use of poison gas for this purpose. (He suggested sulphurous acid fumes.) He advocated also the immunization of the population exposed to plague infection by the use of anti-plague serum as produced in Paris. (The use of the Haffkine type of vaccine in human beings had only just begun and the vaccine was used chiefly for inoculating animals to produce anti-plague serum.)

Simond stated that his work was very incomplete and had been carried on under great difficulties (he mentions for instance the difficulties for working in a tent in the Indian monsoon), but he considered that it justified the conclusions which he enunciated.

These then were the contributions of Simond to the knowledge of plague all made in 1893. It is extremely doubtful if in the history of medicine any single article has ever advanced so many new and original views which have later been confirmed. A proof of the originality of Simond's views is seen in the fact that in the same number of the same journal in which Simond's article appeared, is another sixty-page article on the same subject by Hanken of Bombay, but it contains not even a mention of the flea.

The reception of Simond's views in the medical world was, on the whole, a very cold one. The various plague commissions and most individual writers either ignored or found little or nothing in the theory of flea-transmission.

A few writers later supported the idea of flea-transmission of plague, including Ashburton Thompson and Tidswell in Sydney, Australia in 1900, Gauthier and Raybaud in Marseilles in 1902 and 1903, and Verjbitzki in 1904, but most workers on the subject scoffed at the idea. A scornful editorial comment in the *Indian Medical Gazette* in 1902 spoke of the 'worthlessness' of Simond's flea hypothesis, and quoted Nuttall of Cambridge and Galli-Valerio as having 'pretty completely demolished' it.

In 1905, however, Captain W. G. Liston published a paper in the *Indian Medical Gazette* on the flea-transmission of plague, in which he reported work very similar to that of Simond with very similar conclusions, but he gave no true account of Simond's work and publication, and quoted Simond's article in relation to one small matter, namely, the occurrence of blisters at the site of the insect bite.

In 1905 and 1906 the Indian (Research) Plague Commission of which Liston was a member carried on its work and issued its report which was published in 1906 and 1907 in the *Journal of Hygiene*. This report quotes freely from Simond's paper and entirely supports Simond's views although it does not make clear how much of the work of the Commission was a repetition and an extension of Simond's work.

It is amazing to note that in 1906 the *Indian Medical Gazette* (still under the same editor who published the scornful editorial of 1902) speaks of the flea-transmission theory as having

been enunciated by Liston, actually calls it 'Captain Liston's rat-flea theory', stated that evidence to support the theory is daily accumulating, and in general hails it as new and epoch-making discovery.

As far as is known the *Indian Medical Gazette* never made any apology for the scorn that it had poured on Simond's work and theories. Perhaps now, forty years later, it may do so and help to establish the name of Simond as a great pioneer of plague research. It should be noted, however, that Browning Smith writing in the *Indian Medical Gazette* in 1906 quoted Simond's work and supports Simond's views and that Bacot and Martin (1914) in their article describing the 'blockage' of fleas, acknowledge Simond's work on the flea-transmission of plague. Since then, however, the work of Simond seems to have been largely, if not entirely, forgotten. In one standard history of medicine which the present writer has just consulted, the name of Simond is not even mentioned. Casual references are made in chapters and articles on plague to certain, often minor, aspects of Simond's work by such writers as H. H. Scott in his *History of Tropical Medicine*, but few modern writers can have studied the original article of Simond as a whole, for, if they had done so, they would have been astounded, as was the present writer, that such an outstanding piece of work viewing plague from so many aspects and recorded at such an early date should not be more widely known, and that Simond should not be recognized as the great early worker on plague.

## Medical News

### THE TUBERCULOSIS ASSOCIATION OF INDIA

(Proceedings of the Third Annual General Meeting held on the 26th March, 1942, at the Viceroy's House, New Delhi)

HER EXCELLENCY THE PRESIDENT confirmed the proceedings of the second annual general meeting held on the 25th March, 1941.

Lieutenant-General Sir Gordon Jolly, chairman of the central committee of the Association, presented the report of the Association for the year ending 31st December, 1941, and in doing so he said:—

Your Excellency, Ladies and Gentlemen,

Before I present the report for the year 1941, I should like to express to Your Excellency, on behalf of us all, our pleasure and satisfaction that Your Excellency's stay in India has been extended, and that the campaign against tuberculosis in this country will have the benefit of Your Excellency's knowledge, enthusiasm and driving power for a further period.

A full account of the work of the Association and connected organizations is given in the report which is in your hands, and it is not necessary for me to do more than refer to the more important features of the year.

Three new tuberculosis associations were affiliated to the Tuberculosis Association of India during 1941, and there are now 27 affiliated tuberculosis associations of which 14 are provincial and 13 are State. Seven new

tuberculosis clinics have been opened in different parts of India, 12 are in process of construction, and schemes for three more have been approved. Tuberculosis hospitals have been opened in Travancore State and in Bombay Presidency, and the tuberculosis hospital in Baroda State is nearing completion. A scheme for such a hospital in Udaipur has been approved. Sanatoria have been opened in the Punjab and in Sind, and a project for a sanatorium in Assam has received sanction. Increased accommodation for tuberculous patients and improved arrangements for the diagnosis and treatment of tuberculosis have been provided in many general hospitals throughout India. It is apparent, therefore, that the campaign initiated by Your Excellency is progressing favourably and is indeed gathering impetus.

The New Delhi tuberculosis clinic has during 1941 more than justified the expectations of success which were expressed when it was opened, and I think we can claim that it is rapidly approaching the standard to which we desire a central institution to attain. There have been over 20,000 attendances of patients at the clinic during the short period of its existence, and a particularly satisfactory feature was that, of the patients treated, half were referred to the new clinic from hospitals, maternity and child welfare centres and by general medical practitioners. I interpret this as evidence that the clinic has already secured the confidence both of tuberculous patients and

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of the medical profession. Collaboration with the general practitioner is one of the aims of the institution, and there is now a team of local doctors who co-operate with the clinic staff in the organized home treatment of patients which is advocated by the Tuberculosis Association of India. Sir Shri Ram and his committee and Dr. Sikand and his staff are to be congratulated on the excellent beginning they have made.

While the opening of the New Delhi tuberculosis clinic was the important feature of 1940, the year under report will always be notable in the history of the Tuberculosis Association of India for the institution of the Lady Linlithgow Sanatorium in Kasauli. This sanatorium was, as you know, opened by Her Excellency in May last, and the institution, which by her kind permission bears her name, fittingly commemorates Her Excellency's connection as Founder President with the Tuberculosis Association of India and with the great campaign which owes so much to her inspiration. At the opening of the sanatorium Her Excellency announced a magnificent donation of Rs. 20,000 from herself and another of Rs. 10,000 from His Excellency the Patron. As a result of the construction of 40 cottages, the occupation of which by patients will provide a source of revenue to the sanatorium. Her Excellency has also secured a handsome donation of Rs. 25,000 from a generous donor who prefers to remain anonymous, for a recreation hall and other gifts for equipment such as a cinema outfit and telephone system.

Following upon negotiations carried out with the defence department, wards for the accommodation of forty military patients will be built, the original cost of which is almost completely met from defence services estimates, and the maintenance of which will be paid for by the State for the next ten years. These military wards and twenty of the cottages are under active construction. The number of patients in the sanatorium at present is 88, and further increase is limited only by the uncertainty of the water supply for 1942. Arrangements for an increased supply to the sanatorium have been made and it is hoped that in spite of difficulties occasioned by the war, the additional supply will be forthcoming. It is intended that the sanatorium besides providing modern methods of treatment for patients, will also act as a central teaching centre for doctors and health visitors. This also is dependent upon improved water supply which, it has to be realized, is our limiting factor.

Our most sincere thanks are due to Her Excellency for all she has done to establish and develop this important central institution. We are also indebted to the Pasteur Association of India for their transfer of land and buildings, to the Government of India for their most generous grants, and to all the donors who have made such magnificent contributions of either to the initial cost or to the maintenance of the sanatorium. The medical superintendent, Dr. Joseph, and the medical and nursing staff have worked wonders in the short time that the sanatorium has been open, and provided the water supply difficulty is overcome, the institution can look forward to a successful future. The tuberculosis clinic in New Delhi and the sanatorium at Kasauli will always remain associated with the name of Dr. Frimodt-Möller, the medical commissioner of the Association since its inception until now. What these institutions owe to Dr. Frimodt-Möller's enthusiasm and organizing capacity can never be sufficiently acknowledged. It was a great blow to the Association when Dr. Frimodt-Möller fell seriously ill last August, and the satisfaction at the progress of the work of the Association was clouded by this catastrophe. Apart from Dr. Frimodt-Möller's special interest in the clinic and the sanatorium, his services to the campaign against tuberculosis in the provinces and States of India during his tenure of the post of medical commissioner have been invaluable. His knowledge and experience of tuberculosis in India were

unrivalled, and this gave him an unchallengeable authority as our chief executive officer. You will, I am sure, wish me to make this public appreciation of the services of Dr. Frimodt-Möller as the first medical commissioner of the Tuberculosis Association of India, and of our deep regret that his failing health has made it necessary for him to terminate his connection with the Association.

Dr. Frimodt-Möller's work has, since the end of October, been done by Dr. Benjamin, and I must express the thanks of the Association to Dr. Benjamin for coming to our aid at considerable inconvenience to himself, and also to the Union Mission Committee for generously allowing us the benefit of Dr. Benjamin's services during these months.

The details of the work done by the medical commissioner and his 'locum tenens' during the year are given in the report. An unfortunate result of Dr. Frimodt-Möller's illness has been somewhat to hold up the various training schemes and post-graduate courses based on the New Delhi tuberculosis clinic and the Kasauli sanatorium, but it is hoped that in due course these schemes will be completed and put into execution. Two short post-graduate courses were conducted by the Association during 1941, one in Bombay and one in Calcutta. These courses are being continued during 1942 in Patna and in Lahore. During the year, an important report on the standardization and classification of pulmonary tuberculosis has been prepared by a sub-committee appointed by the Tuberculosis Association of India, and has been published in booklet form. As in the previous years, a special tuberculosis number of the *Indian Medical Gazette* was published, while the publication of the Association was the proceedings of the second tuberculosis workers' conference held towards the end of the year 1940.

This, Your Excellency, closes my brief survey of the most important features of the work of the Association during 1941. The year has been a busy one and I would like to record my own and my committee's grateful thanks to our honorary treasurer, Sir Cameron Badenoch upon whom a particularly heavy burden has fallen and whose wise counsel has at all times been placed unreservedly at our disposal. To the members I am particularly indebted for their executive support and guidance in the affairs of the Association. Our secretary, Rai Bahadur Dutt, and the office staff have worked to my entire satisfaction.

Sir Cameron Badenoch, honorary treasurer of the Association, presented the audited accounts for 1941. The meeting proceeded to the election of two women members on the central committee under rule 3 (viii) and after voting had taken place Her Excellency the President declared the following persons as elected to the central committee:—

1. Dr. G. Stapleton, C.M.O., W.M.S.
2. The meeting proceeded to the election of 5 members on the central committee under rule 3 (ix) and after voting had taken place Her Excellency the President declared the following persons as elected to the central committee:—
1. S. B. Teja Singh Malik, C.I.E., I.S.E.
2. R. B. Captain K. S. Nigam, M.D., F.R.C.S.
3. Major-General W. C. Paton, M.C., I.M.S.
4. Dewan Bahadur Balasundaram Naidu, C.I.E.
5. Mr. G. Kaula, C.I.E.

Her Excellency the President addressed the meeting as follows:—  
Once more I have the pleasure of welcoming you and I think you will agree that the Tuberculosis Association of India and its affiliated associations have not allowed the grass to grow under their feet during this last year. Progress goes steadily forward and interest is increasing. I have the opportunity during my tours through India of not only seeing sanatoria and clinics but of talking to those who are engaged in tuberculosis work in those areas and I have been



very much struck by the enthusiasm displayed by those who had taken up the work and who before had hardly realized the existence of this menace in their midst.

Since our annual general meeting last year I have had the pleasure of opening the sanatorium at Kasauli of which Sir Gordon Jolly has given you details. Some of you may have seen the photographs published in the *Illustrated Weekly* of this most lovely spot. When I visit it I always feel that the mere fact of sitting on the verandah absorbing the beauty of the mountains and inhaling the clear sweet air which comes straight from the summits must rehabilitate one in body and in mind. We are fortunate in our superintendent, Dr. Joseph, and the reports which he sends me from time to time show that the patients are happy and are doing well. Some of you may know the difficulty experienced in persuading patients to stay in the hills during the cold weather, but in the last report which I have had Dr. Joseph tells me that he had been able to keep them all.

I have also visited the clinic in Nagpur which is certainly one of the best in India and is doing admirable work. I saw the site for the clinic which is being built in one of the most crowded areas of Calcutta by the Servants of Humanity Society, but at the moment work is held up owing to difficulty of getting materials. In Sind I opened a sanatorium 8 miles from Karachi which will provide an interesting experiment as provision is made for both allopathic and ayurvedic treatment. The patient will be given the choice as to which he prefers, and if the two doctors work in together and compare notes, I feel that each may derive benefit from the other's experience.

I am always rather apprehensive for the future of buildings on scale of this one which have no endowment and I wish that people would take as great an interest in the endowments of buildings as they do in their erection. I fear the custom is too prevalent of putting up a building and expecting Government to keep it going. Recently in Patiala I laid the foundation stone of a first-rate sanatorium and was delighted to find that the State had accepted Dr. Frimodt-Möller's scheme of organized home treatment in full. Two days ago I went to the Model Clinic in Delhi and was able to see the important place which it has made for itself in the scheme for Delhi Province and I am satisfied that the name 'Model Clinic' is being lived up to in the fullest sense of the word.

I feel I cannot close my remarks without paying a personal tribute to Dr. Frimodt-Möller, the first medical commissioner of the Tuberculosis Association of India. His knowledge of the disease, his energy, his organizing ability, his missionary spirit, have been of invaluable help in the start of this Association and of the many associations affiliated to it. His advice was sought in every part of India and his tours must have covered many hundreds of miles. He never spared himself and he inspired all those with whom he came in contact with his own enthusiasm. We as an Association will miss his guiding hand sorely and I will miss him also as a friend and as a collaborator in the work which we both have so much at heart. I know that I carry you all with me when I express to him our profound gratitude for the work he has done for India and our heart-felt wishes go with him for the recovery of his health.

As Sir Gordon Jolly told you, Dr. Benjamin has carried on and we are grateful to him and the Mission which has spared him. I hope Dr. Benjamin will stay on.

The time has now come to appoint another medical commissioner and I feel that the Association would like to have the chance of putting up nominations. This will now be circulated to all the associations. Meanwhile, we propose to ask the United Missions Committee to spare Dr. Benjamin's services to us for a bit longer until arrangements for his successor can be made. I do not think there is anything more to

say, except that all the associations will be circulated for their nominations.

Sir V. T. Krishnamachari proposed a hearty vote of thanks to Her Excellency the President.

#### MINUTES OF THE MEETING OF THE UNITED PROVINCES MEDICAL COUNCIL HELD IN ITS OFFICE AT LUCKNOW ON FRIDAY THE 27TH MARCH, 1942, AT 11 A.M.

The two following items were included in the minutes:—

The following resolution was considered: 'This Council thinks that the strike by the house staff of the King George's Hospital was a serious offence against the professional conduct of registered medical practitioners and those who took part in it should be dealt with under section 26 of the United Provinces Medical Act'.

A point of order was raised.

It was decided that the resolution as it stands is not according to the procedure in that names are not mentioned. There should be a specific complaint against a specific individual or individuals and anybody may bring forward a proper complaint as required by rule 2 of the rules for the conduct of inquiries under section 26 of the Act.

The following resolution was passed:—

'The United Provinces Medical Council recommends to the Government of India through the United Provinces Government to be pleased to recognize the medical qualifications recognized by the Council as registrable by Indian Medical Council during the present emergency following the precedent adopted by the British Government under Defence Regulation 32-B, by which medical qualifications, hitherto unrecognized have been declared temporarily registrable by the General Medical Council.'

The resolution be forwarded to the Government of India through the Provincial Government for favourable consideration.

#### MEDICAL SUPPLIES TO CHINA

'I SPENT a busy week exploring their difficulties, learning much of what can be done with courage and capacity in the face of gravely curtailed resources and appreciating the spirit of dogged determination that lies behind the Chinese war effort', said Lieut.-General Sir Gordon Jolly, Director-General, Indian Medical Service, giving an account of his recent visit to Chungking in a broadcast from the All-India Radio. 'My immediate contacts in Chungking', he said, 'were to be with the medical authorities and there on the ... greet me were General Loo Chih Teh, ... of the Chinese Army Medical Services, a man on whom has been laid the heavy burden of organizing and equipping the military and medical services of his country in the face of great difficulties in regard to both personnel and supplies; Dr. P. Z. King, Head of the National Health Administration, whose task of providing medical relief for the civil population and preventing the spread of epidemics after many years of war would break the heart of anyone less patient and less resourceful; and Dr. Robert Lim, Director of the Chinese Red Cross, a graduate and former member of the physiology staff of Edinburgh University who speaks English with the homely accent of that town. He controls the Red Cross Medical Relief Corps and the highly efficient Medical Service Training School at Kwei-Yang.

'With these ... I spent a busy week. We examined ... a wide range of medical supplies including those manufactured in China, those which India may be able to supply and those which need to be imported from elsewhere. We also formulated plans for better liaison with one another and discussed the prevention and control of epidemic disease, particularly bubonic plague.

'Interviews with Dr. Foo, the Vice-Minister for Foreign Affairs and later with the War Minister,



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General Ho Ying Chin, helped to give me an insight into the problems that have confronted the Chinese in their determined resistance against Japanese aggression and into the methods that have kept them unbeaten. At a special exhibition organized by the War Minister to demonstrate to military officers war production in Free China, which General Ho invited me to view, I was greatly impressed by the range and quality of the munitions and other supplies displayed. In this section dealing with medical stores I noted that many of the drugs we make in India are also manufactured in Free China, while I saw and examined some excellent surgical instruments and a particularly fine exhibit of artificial limbs.

'General Denny's' death made it necessary for me to make certain medical contacts in Burma, which meant my leaving at once, but before doing so Generalissimo Chiang Kai-shek was good enough to give me an interview at very short notice. It took place in His Excellency's house at 9 p.m. The objects and results of my visit were discussed and various proposals for co-operation in regard to medical personnel and stores received the Generalissimo's approval. As a first instalment of these it has already been arranged to give Chinese medical officers special training facilities in India and to release to China from Indian stocks five million tablets of quinine.

### TERMS AND CONDITIONS OF RECRUITMENT OF EMERGENCY INDIAN COMMISSIONED OFFICERS TO THE MILITARY CADRE OF THE INDIAN MEDICAL SERVICE DURING WAR FOR SERVICE WITHIN INDIAN LIMITS

*Type of commission and method of appointment.*—The additional temporary medical officers required by the military authorities for service within Indian limits will be appointed by the Government of India on the recommendation of the Indian Medical Service Selection Board from candidates who have applied to the Director-General, Indian Medical Service, for appointment. These officers will be granted emergency commissions in His Majesty's Indian Land Forces for the duration of the War and for so long thereafter as their services may be required. They will be on probation for a period of 6 months in the first instance and those found unsuitable will be gazetted out of the Service. Candidates will normally be required to appear for an interview before the nearest provincial administrative medical officer, and will have to undergo a medical examination which will ordinarily take place at the time of the interview. Unless the Selection Board decides otherwise they will also be required to appear for an interview before the board or the Director-General, Indian Medical Service. For journeys in India in connection with the board and medical examination candidates will be allowed travelling and daily allowances.

*Qualifications for appointment.*—In order to be eligible for consideration an applicant must—

- (i) be either—
  - (a) a male British subject of Indian domicile whose father (if alive) is a British subject or a subject of a State in India, or a British protected person of the tribal areas; or (if dead) was at the time of his death either a British subject or a subject of a State in India, or a British protected person of the tribal areas, or a person in permanent service of the Crown, or a person who had retired from that service; or
  - (b) a Ruler or a subject of a State in India, provided that the requirements of parts (a) and (b) of this rule may be waived at the discretion of the Government of India;
  - (ii) possess a medical qualification registered in Great Britain and Northern Ireland under the Medical Acts in force at the time of his appointment or an Indian medical qualification recognized under section II(2) of the Indian

Medical Council Act, 1933, or any other medical qualification considered adequate by the Selection Board and registered in British India under one of the Provincial Medical Acts; and be, in the opinion of the Government of India, in all respects suitable to hold a commission in the Indian Medical Service.

*Age limit.*—A candidate should normally not have attained his 40th birthday at the date of appointment. The Selection Board may, however, waive the age limit at its discretion in individual cases.

*Antedate of commission.*—(a) An officer will be eligible for an antedate in consideration of professional experience, equal to half the period from the date of his medical qualification to the period of his appointment to an emergency commission in the Indian Medical Service, subject to a maximum of 5 years.

(b) An officer who has held an approved whole-time appointment in a recognized civil hospital may be granted an antedate equivalent to the period of his appointment but not exceeding one year. The period spent in hospital and appointments will not count twice in reckoning the total antedate admissible under clause (a) and this clause.

(c) An antedate not exceeding 6 months may be granted to a candidate who, at the time of selection, is in possession of a Diploma of Public Health registered by the General Medical Council or of a qualification recognized by the General Medical Council as in all respects equivalent to the Diploma of Public Health and as involving a similar period of post-graduate study.

In the case of a candidate who is eligible for an antedate under clauses (b) and (c) above the total period of antedate under those clauses will be limited to one year.

(d) The Government of India may also grant to an officer at the time of his appointment an antedate not exceeding 12 months, in respect of higher qualifications obtained prior to appointment, which in their opinion justify such grant. Such an antedate may be granted in addition to antedate under clauses (b) and (c) but will in no case exceed 18 months in all.

The maximum period of antedate admissible under this paragraph is 6 years and 6 months. The period of antedate will count as commissioned service for increments of pay and promotion but not for gratuity. In no case will an antedate carry back pay.

*Rank and promotion in rank.*—An officer will be appointed to the rank of Lieutenant, and if in all respects qualified and recommended, he will be promoted to the rank of Captain on completing one year's full pay service.

*Pay and allowances.*—The issue of pay and allowances is subject to the general conditions prescribed in the Pay and Allowance Regulations for the Army in India. The following are the monthly rates of basic pay payable from the date of joining for duty:—

| Rank and service in rank             | Basic pay in rupees per mensem |
|--------------------------------------|--------------------------------|
| Lieutenant                           |                                |
| Captain, during 1st year as such     | 300                            |
| " " 2nd and 3rd year as such         | 350                            |
| " " 4th and 5th year as such         | 400                            |
| " " 6th and subsequent years as such | 450                            |
|                                      | 550                            |

In addition to pay, officers who are appointed to hold certain posts will be granted additional pay as shown below:—

Specialist pay at Rs. 100 per mensem will be admissible to an officer who is appointed as a specialist. Command pay from Rs. 60 to Rs. 240 will be admissible to an officer appointed as officer commanding, or in the case of larger hospitals, as second in command of an Indian Military Hospital.

Charge pay varying from Rs. 80 to Rs. 240 per mensem will be admissible for the medical charge of staffs of certain stations, depots, factories, etc., and at Rs. 60 per mensem for an officer in charge of a brigade laboratory.

For holding charge of a Cantonment Hospital or Cantonment Dispensary an officer will be eligible for such allowance as may be approved by the Cantonment authorities concerned and sanctioned by the General Officer Commanding-in-Chief, the Command.

*Note.*—The above rates are liable to change from time to time.

*Outfit allowance.*—Subject to the provision of paragraph 14(c) an officer will be granted on appointment an allowance of Rs. 533.

*Uniform, etc.*—The uniform will be the same as for regular officers of the Indian Medical Service. Instructions regarding the articles of uniform to be maintained will be issued on appointment by the military medical authorities.

*Leave.*—Will be governed by the rules applicable to regular officers as authorized from time to time.

*Gratuity.*—An officer on release from army service will receive a gratuity computed as follows:—

- (i) For the first completed year of army service.
  - (a) If he obtained the basic registrable qualification before the 1st January, 1940—Rs. 2,000.
  - (b) If he obtained the basic registrable qualification on or after the 1st January, 1940—Rs. 1,000.
- (ii) For each subsequent completed year of army service, one month's pay.

*Pensionary concessions on account of disabilities, etc.*—An officer who has been pronounced permanently unfit for service within Indian limits owing to a 100 per cent disability attributable to military service, may, on relinquishment of his commission on account of such disability, be granted pension at the rate of Rs. 2,000 per annum. Proportionate rates may be granted for less disability down to 20 per cent. No addition for service shall be made. The amount and continuance of the award will depend on the degree and duration of the disability.

Pensions and compassionate allowances to widows, children and dependents of officers whose deaths are due to wounds, injuries or disease directly attributable to conditions of military service will be admissible under the same conditions and to the same extent as authorized for permanent Indian Commissioned Officer of the Service, e.g.—

|   |    |                           |
|---|----|---------------------------|
| (a) Widow—  |    |                           |
| Rank of officer   |    |                           |
| Lieutenant  | .. | Rupees per annum          |
| Captain   | .. | 1,200                     |
| ..  | .. | 1,340                     |
| (b) Legitimate children—  |    |                           |
| (i) Children's allowance for each child irrespective of the rank of the officer.  | .. | 320 (535, if motherless). |
| (ii) Educational allowance which may be granted in special cases in addition for each legitimate child in case of pecuniary needs, etc. | .. | Not exceeding 310.        |

The gratuity admissible to the widow of an officer killed in action shall be:—

|                 |    |                            |
|-----------------|----|----------------------------|
| Rank of officer |    | Amount of gratuity, rupees |
| Lieutenant      | .. | 2,000                      |
| Captain         | .. | 2,670                      |

*Termination of service.*—The services of an officer will be terminated normally at any time after the war

is over, but his services shall, at any time, be liable to be dispensed with in the event of any misconduct on his part, of which misconduct the Government of India will be the sole judge, and if his services are so dispensed with he shall automatically forfeit the gratuity specified in paragraph above.

*Applicability to ex-temporary and short service commissioned I.M.S. officers.*—The preceding terms and conditions will apply to ex-temporary and ex-short service commissioned to officers of the Indian Medical Service recruited to emergency commissions in the following modifications:—

- (a) They will count all previous commissioned service in the Indian Medical Service towards pay, promotion and seniority;
- (b) they will be junior to Army in India Reserve of Officers Category 8 (Medical) with the same length of service;
- (c) they will receive the outfit allowance of Rs. 533 only if their previous service in the Indian Medical Service terminated 3 years before the dates of appointment to emergency commissions.

Provided that an ex-short service commissioned officer who is appointed to an emergency commission without a break in service shall be senior to an officer of the Army in India Reserve of Officers Category 8 (Medical) with the same length of service. Officers recruited under these terms and conditions will not be considered for permanent commissions in the Indian Medical Service unless they have transferred to General Service Cadre.

#### APPENDIX 1

##### Form of declaration

I, the undersigned, hereby promise and declare that if I am granted an emergency commission I will serve His Majesty the King-Emperor of India, his heirs and successors, as an officer of His Majesty the King-Emperor's Indian Land Forces (Indian Medical Service), so long as my services may be required or until my resignation is accepted and that I will serve in any place to which I may be sent within Indian limits.

Signed this

Witness.

Signature and date.....

Address.....

day of

Signature of applicant. 19 .

#### THE INDIAN HONOURS LIST

11TH JUNE, 1942

The following are the names of medical men, and others associated with medical institutions, in the Indian Honours List of date 11th June, 1942. We offer them our congratulations.

##### *Knighthood*

Major-General J. Taylor, C.I.E., D.S.O., I.M.S., Director, Central Research Institute, Kasauli.

##### *C.I.E.*

Lieutenant-Colonel A. H. Shaikh, I.M.S., Inspector-General of Prisons, United Provinces.  
Lieutenant-Colonel G. R. McRobert, I.M.S., Professor of Medicine, Medical College, Superintendent and Physician, General Hospital, Madras.  
L. Everard Napier, Professor of Tropical Medicine and Director, School of Tropical Medicine, Calcutta.

*O.B.E. (Civil Division)*

Major F. D. Deatker, I.M.D. (retired), District Superintendent, No. 3 District, St. John Ambulance Brigade Overseas, Bombay.

*M.B.E. (Civil Division)*

Miss Jerusha Jhirad, Medical Officer-in-Charge, Cama and Aibless Hospitals, Bombay.

Lieutenant-Colonel K. K. Chatterjee, District Superintendent, St. John Ambulance Brigade, Bengal.

Lieutenant J. E. Howard, I.M.D., Assistant Port Health Officer, Karachi.

Rai Bahadur S. H. Pandit, Lecturer in Surgery, King Edward Hospital Medical School, and Medical Officer-in-Charge, Ophthalmic Department, K. E. M. Hospital, Indore.

S. M. Sarwar, Esq., Superintendent, Civil Veterinary Department, North-West Frontier Province.

*Kaisar-i-Hind Gold Medal*

Miss Hilda Mary Lazarus, W.M.S., Principal, Lady Hardinge Medical College, Delhi.

Miss Ida Mary Roberts, Medical Officer-in-Charge of the American Hospital for Women and Children, Madura, Madras.

A. C. Ukil, Esq., Senior Honorary Visiting Physician, Chest Department, Medical College Hospitals, Calcutta.

*Bar to the Kaisar-i-Hind Gold Medal*

C. F. Frimodt-Möller, Esq., C.B.E., Medical Commissioner, Tuberculosis Association of India.

*Kaisar-i-Hind Silver Medal*

Mrs. Aalice Helen Duncan, retired Lady District Superintendent, St. John Ambulance Brigade Nursing Division, Calcutta.

Miss Florence Ruth Hart, Doctor-in-Charge of the Church Missionary Society Hospital, Multan Cantonment, Punjab.

Miss Eva Marks, Hospital Matron, Peshawar Indian Troops Zenana Hospital, North-West Frontier Province.

N. J. Everard, Esq., In-charge, Mission Hospital, Kachwa, Mirajpur District, United Provinces.

G. Henderson, Esq., Medical Officer-in-Charge, Mission Dispensary and Leper Asylum, Sankeshwar, Belgaum District, Bombay.

Captain V. K. Mehendale, Medical Practitioner, Sholapur, Bombay.

*Bar to the Kaisar-i-Hind Silver Medal*

Miss Janet Alexander, In-charge, Mission Hospital, Montgomery, Punjab.

*Kaisar-i-Hind Bronze Medal*

Miss Mona Ishwardei Das, Lady Doctor-in-Charge, Indian Troops Welfare Centre, Meerut, United Provinces.

Lala H. C. Khosla, Senior Sub-Assistant Surgeon-in-Charge, Civil Dispensary, Beri, Rohtak District, Punjab.

Lala B. L. Malhotra, District Leprosy Officer, Kangra District, Punjab.

*Khan Bahadur*

Dr. M. Yacob, Assistant Director of Public Health, Epidemiology, and Personal Assistant to the Director of Public Health, Punjab.

*Rai Bahadur*

Rai Sahib S. C. Sarkar, Police Surgeon, Calcutta.

Rai Sahib R. P. Ghosh, Medical Practitioner, Samastipur, Bihar.

M. Chatterjee, Esq., Civil Surgeon, Bilaspur, Central Provinces and Berar.

Rai Sahib D. N. Ahluwalia, Chief Medical Officer and General Minister, State Council, Bundi State, Rajputana.

Rai Sahib K. Chand, Assistant to the Director, Malaria Institute of India, Kasauli.

*Rgo Bahadur*

Major T. V. P. R. Pillai, A.I.R.O., Superintendent, Government Royapettah Hospital, and Surgeon, IV District, Madras.

T. Satakopan, Esq., Honorary Physician, Government General Hospital, Madras.

B. Badami, Esq., Director, Veterinary Department, His Exalted Highness the Nizam's Government, Hyderabad, Deccan.

*Shifa-ul-Mulk*

Hakim Nizamuddin, Proprietor of the Nizami Dawa Khana, Ajmer.

*Rai Sahib*

R. R. Mukherjee, Esq., Editor, *Bankura Darpan* and Medical Practitioner, Bankura, Bengal.

K. N. Bhattacharjee, Esq., Medical Practitioner and Honorary Magistrate, Rangpur, Bengal.

B. D. Wadhwa, Esq., Municipal Medical Officer of Health, Moradabad, United Provinces.

H. R. Aggarwal, Esq., V.H.S., Vice-Principal and Lecturer in Pathology, Medical School, Amritsar, Punjab.

B. N. Banerjee, Esq., Assistant Surgeon, Dhanbad Hospital, Dhanbad, Bihar.

S. K. Ghosh Dastidar, Esq., Lecturer in Medicine, Medical College, Patna, Bihar.

J. S. Dutta, Esq., Medical Practitioner, Muzaffarpur, Bihar.

A. P. Sinha, Esq., Civil Surgeon, Koraput, Orissa.

R. L. Badhwar, Esq., lately Chief Botanist, Medicinal Plants and Food Poisons Inquiry, School of Tropical Medicine, Calcutta.

*Rao Sahib*

K. N. Nair, Esq., Stanley Medical College, Madras.

N. S. N. Ayyar, Esq., Lecturer in Orthopaedics, Medical College and Surgical Registrar, General Hospital, Madras.

M. N. R. Nayudu, Esq., Medical Practitioner, Ellore, West Godavari District, Madras.

C. H. Rao, Esq., Medical Practitioner, Guntur, Madras.

M. Ponnayya, Esq., District Veterinary Officer, Coimbatore Circle, Madras.

C. H. Karnik, Esq., Medical Officer, Sawantwadi State.

*O.B.I.*

*To the First Class with the title of 'Sardar Bahadur'*

*Indian Medical Department*

Sub-Maj. and Hony. Lieut. Bachint Singh, Bahadur.

Sub-Maj. and Hony. Lieut. Rai Sahib Karam Chand Kapur, Bahadur.

Sub-Maj. and Hony. Lieut. Rai Sahib Bishnu Das Sawhney, Bahadur.

Subdr. Khan Sahib Fazal Ilahi, Bahadur.

Sub-Maj. and Hony. Lieut. Diwan Chand, Bahadur.

Sub-Maj. and Hony. Lieut. Vithal Mahadeo Satpute, Bahadur.

Sub-Maj. and Hony. Capt. Rai Sahib Ram Ditta Mall, Bahadur.

*To the Second Class with the title of 'Bahadur'*

*Indian Medical Department*

A/Sub-Maj. Lal Singh.

Sub-Maj. and Hony. Lieut. Rao Sahib Ramisetty Subbayya.

Subdr. Ata Muhammad, I.O.M.

A/Sub-Maj. Mewa Ram Vashisht.

A/Sub-Maj. Bansi Dhar Tripathi.

No. 1607 Jemdr. Puran Singh.

A/Sub-Maj. Amritrao Chimanrao Malwade.

A/Sub-Maj. Darwan Singh.

## Public Health Section

### RURAL SANITATION—A KEY TO SUCCESS

By GAURCHANDRA GHOSH, B.E., M.R.SAN.I.

THERE is a growing demand for the improvement of rural sanitation in India, and many voluntary organizations such as health leagues, co-operative anti-malaria societies, etc., are coming into existence in rural centres. Such organizations always start with a great deal of initial enthusiasm, specially when inaugurated under official influence, but soon die a natural death for lack of co-ordination and want of a definite workable programme.

Any programme of rural sanitation should be drawn up on the basis of the following major considerations :—

- (i) Existing field conditions.
- (ii) Type of executive agents available for the guidance of the workers.

An ideal programme dealing simultaneously with all the problems, big and small, is never workable. It should always be built around one main marketing project which depends on local conditions. Whereas ventilation might be an important problem in the United Provinces, it is of secondary importance in Bengal where the huts have always sufficient ridge ventilation. On the other hand, malaria would be problem no. 1 for Bengal, but may not be so in other parts.

Small isolated and backward villages should always form the nucleus for working out any new methodology for improvement of rural sanitation based on mutual co-operation and self-help. The writer was associated with the work of a health centre situated in a semi-rural area, not far from a big city. Most of the male adult population in the area are daily passengers to city offices, going out early in the morning and coming back tired in the evening. These 'daily-passengers' (as they are popularly called), owing to their constant contact with a big city, consider themselves to be the cleverest of all people, and think that they know everything of all things. Moreover, they could spare very little time to think of public health work. An anti-malaria scheme was introduced in such an area. The scheme was drawn up with the hope that the villagers themselves would co-operate and no expenditure would be incurred on such items as clean weeding of tanks and *dobas*, digging of village drains, minor drainage, etc. All the prominent and influential men of the area were invited to a meeting in which the scheme was discussed. A committee was elected, which was to organize volunteers and submit their recommendations in a subsequent meeting. This second meeting was attended by a single gentleman who happened to be the father of a local clerk of the health centre. So

much for co-operation. Then when the scheme was introduced and a surveyor was preparing a map of the area, he was seriously maltreated and threatened to be handed over to the police, by the owner of a particular tank (open and away from houses) for going round it and fixing flags.

In contrast with this, the writer had experience of working in a village—very backward and far remote from cities. With a view to preparing a malaria control scheme for this area (consisting of five villages) a malaria engineering survey was undertaken in which the villagers co-operated to the extent of providing voluntarily three to six labourers to work as survey coolies every day for a period of about one and a half months. Unfortunately however the control scheme for this area was ultimately dropped.

The second major consideration in drawing up a programme of rural sanitation is the type of technical personnel available for working out the programme. The key man for this kind of work is the sanitary inspector. Under the existing conditions in India the term sanitary inspector is a misnomer. Their major duties consist of vaccination and collection of vital statistics and they can devote very little time to think of environmental sanitation. Nor are they properly trained or qualified enough to carry out the right type of sanitary measures. They are more or less semi-medical officers of health, who not only carry out vaccination and inoculation but are also supposed to diagnose and record diseases (for purposes of statistics) which even trained and qualified medical men are unable to do without the use of proper instruments and laboratory facilities. About the efficiency of such a system the less said the better.

The following describes the duties of a sanitary inspector, in an advanced community:—

'It will be his duty to investigate nuisances and complaints, make sanitary surveys, inspect dairy farms, mosquito breeding grounds, and the drainage area of the watershed upon which the town supply is collected, and to undertake the various miscellaneous outside duties such as the collection of milk samples for laboratory examination, the inspection of markets, etc.' He should also report on any obnoxious or offensive trades, waste or fouling of water, inspect shops relating to ventilation, temperature and sanitary conditions, report on occurrences of infectious or epidemic diseases and arrange for isolation of cases and disinfection, report on overcrowding and supervise scavenging services. 'The position of sanitary inspector calls for a man who is first of all diligent and responsible. He should have a well-developed detective instinct and an abundant supply of tact.'

Pending a reorganization on the above lines little real work on rural sanitation can be successfully carried out. Environmental sanitation must gradually replace the medical functions of the sanitary inspectors. This will also need a reorientation of the course of training for the sanitary inspectors. More stress must be laid on the practical side of things and they must

learn to use their own hands. They should, for example, be able to drill bored-hole latrines, sink tube-wells, and carry out simple repairs. Hundreds of tube-wells in rural areas are remaining out of use for want of simple repairs. Here a bolt is missing, there a piston rod is broken or the valves are worn out—defects which the sanitary inspectors can easily learn to remedy. If again, they are to help in malaria control projects, they must not only learn all the technique such as use of sprayers, larvicides, etc., but must also know how to collect larvae and identify them, and most important of all must have an exact idea as to what is being aimed at as regards the malaria vector for the particular area. Insufficient knowledge in this direction is very dangerous. For example, in some places, indiscriminate opening up and clearing of jungles (which is a very popular item of work for many lay organizations) may actually do more harm.

There is no end to the types of constructive works the rural health organizations could carry out under the directions of properly qualified and trained sanitary inspectors. A number of such items are indicated in the programme given below. This was drawn up as a special detailed programme that might be undertaken for a health week by the Village Health Leagues in Bengal.

#### *Programme for health week*

The programme indicated below is a general one and may need modification for particular areas depending on local conditions.

**Water supply.**—Tanks as sources of drinking water supply are very rapidly becoming obsolete, being replaced by tube-wells in many places. There is a general consciousness even in the remotest villages, regarding desirability of using pure water for drinking purposes, and people would even take the trouble of walking a good distance to collect water from a distant tube-well. Excavation, re-excavation, or protection of tanks for purposes of safe drinking water sources is therefore not recommended except under rare conditions where tube-wells or open wells are not in existence.

1. **Protection of tube-wells.**—Most tube-wells are however unprotected and give a false sense of security. A tube-well must be protected from surface pollution. To ensure this it is necessary that waste water from the tube-well is led away to a sufficient distance from the well. There should be a water tight platform surrounding the tube-well. The following is a typical specification :—

Three-inch beaten terrace floor [lime concrete in the proportions : lime 1 part + sand  $1\frac{1}{2}$  parts + *sirkhi*  $1\frac{1}{2}$  parts + brick chips ( $\frac{1}{2}$  inch) 5 parts], 5 feet  $\times$  5 feet over a brick flat,  $\frac{1}{2}$  inch cement plaster over the floor (proportion 1 part cement + 2 parts sand). Three-inch wide brick band round the floor in cement mortar and cement plastered. A 6-inch wide concrete drain at least 20 feet long to lead the waste water away from the tube-well. The floor should have a slope of 1 inch from the centre towards the drain. Brickwork in cement round the pipe, 3 feet 6 inches height  $\times$  10 inches, of which at least 2 feet should be below the ground level.

2. **Repairs to tube-wells.**—Many tube-wells get out of order due to want of minor repairs. Such simple repairs can be very easily carried out by ordinary people, once they are shown how to do it. The following are the usual defects :—

(i) **Leather bucket.**—This gets worn out in about 6 months to 1 year, when it has to be changed.

(ii) **Washers and valves.**—These also get worn out and may be easily replaced.

(iii) **Piston rod.**—This lasts for at least two years and costs about a rupee; it can be easily changed.

(iv) Bolts and nuts often get worn out or broken.

Tools required for opening the pump are two pipe wrenches and a screw wrench. When refitting the pump to the pipe base all the nuts should be tightened simultaneously bit by bit, as otherwise the casting is liable to break. Bolts, nuts and washers should be occasionally oiled with mustard oil as otherwise they get rusted and it becomes difficult to open them.

Even where tube-wells are all in working order it would be a good plan, for purposes of demonstration to the villagers, to dismantle the pumps (by sanitary inspectors or mistries) and show how to change the different parts and assemble them.

3. **Chlorination of open wells.**—Bleaching powder is widely used for disinfection of water. It contains, when fresh, about 33 per cent of available chlorine, but being very unstable it is considered not to possess more than 25 per cent of available chlorine, under working conditions.

Before chlorinating a well its volume of water must first be determined. The diameter and depth of water are measured (in feet) by means of a tape. The volume (in cubic feet) will be

$$\frac{22}{7} \times \frac{\text{diameter} \times \text{diameter}}{4} \times \text{depth of water.}$$

To convert this into gallons the figure has to be multiplied by  $6\frac{1}{4}$ .

The chlorine dose will vary according to the amount of organic impurity present in the water. The usual dose is 1 part per million (p.p.m.). This works out to 7 grains of available chlorine for 100 gallons of water. Assuming bleaching powder to contain 25 per cent available chlorine we would require 28 grains of bleaching powder for 100 gallons of water. If a stock solution is made such that 100 c.cm. of it contains 28 grains of bleaching powder then for every gallon of water to be disinfected we would require 1 c.cm. of this stock solution, for a dose of 1 p.p.m. The required amount of stock solution is poured into the well and then the water is thoroughly agitated by means of a bucket tied to a rope.

It will however be found that bleaching powder, if not properly kept, will have lost much of its strength. For this reason a sample of 1 gallon of the water to be treated is first collected in a bucket. To this sample is added, say, 1 c.cm. of the stock solution.

For proper disinfection it is necessary that there should be some residual chlorine in the water, after treatment (this can be tested 30 minutes after application by adding 0.5 c.cm. of orthotolidine solution to 10 c.cm. of sample of water). If orthotolidine solution is added to water containing chlorine, the water turns yellow.

The sample of chlorinated water is tested for residual chlorine. The procedure should be repeated with different doses till the correct dose which just indicates some residual chlorine is determined. Once the dose per gallon of water

is determined the required amount of stock solution for the volume of water in the well can be easily calculated.

Open wells should be kept covered. There should be a common rope and a bucket for drawing water. A simple arrangement of pulleys is desirable.

4. *Reserved tanks.*—In villages where there are no tube-wells or masonry wells, one or more tanks should be kept reserved for supply of drinking water. These tanks should be cleared of vegetation which should be removed away from the banks. All jungles and trees on the banks are to be cut off. Trees and shrubs on the banks of tanks provide privacy for the people defecating on the banks. The banks should be raised with earth so that no surface water can get into it.

*Chlorination of tanks.*—A stock solution of bleaching powder in water is prepared. This is carried to the middle of the tank in a small boat or fisherman's raft. The solution is to be poured into the tank working radially from the centre outwards in all directions and the water is to be thoroughly agitated.

The old method of tying a bag of bleaching powder on to the middle of a bamboo pole and working it backwards and forwards by two men holding the pole at two ends does not work satisfactorily and is not recommended.

5. *Digging of village drains.*—In digging a drain the first point to consider is the point at which the sullage water is to be finally disposed of, i.e., the outlet. This outlet must be at a lower level than the drain, otherwise there will be stagnation of water.

The drains should be straight as far as possible and change in direction is to be provided by means of smooth or circular curves.

6. *Kitchen garden.*—Sullage water in villages may be very well disposed of by watering kitchen gardens. Where this is not possible, bored-holes or soakage pits may be provided.

7. *Soakage pits.*—These may be used as urinals or for disposal of sullage water. A circular pit 4 feet diameter is dug to a depth of about six feet. This is filled with broken *jhama* (overburnt brick) chips starting from 2-inch size at the bottom to  $\frac{1}{2}$  inch on the top. The pit, when used as a public urinal for men, is divided diametrically into four sections by means of vertical screens 3 feet high. Ordinary bamboo matting or *hogla* may be used as screens. Two bricks are placed in each section for use as foot rests. For women, another rectangular enclosure for the sides is required in addition.

When used for disposal of sullage water no screens are necessary and one pit may serve four houses.

8. *Bored-hole latrines.*—Bored-hole latrines in many places are more or less in an experimental stage, and where most of the tube-wells are either shallow or unprotected, mass production of bored-hole latrines is not recommended.

This should only be undertaken where the site is carefully selected by the sanitary inspector or other health personnel, and the necessary equipments are available.

A bored-hole latrine is a round hole bored into the earth with an auger 16 inches in diameter. The depth to which it is bored depends on the sub-soil water level. There should be a minimum of about 3 feet of water during the dry season.

A hole about 6 inches deep and 16 inches in diameter is first dug and the auger is placed in this hole and rotated in a clockwise direction. When the auger is filled it is lifted up and the earth is emptied. It is again put back into the hole and the process is repeated till the desired depth is reached.

If the soil is very loose and the hole tends to cave in, it can be protected by putting in a bamboo lining. (figure 1).

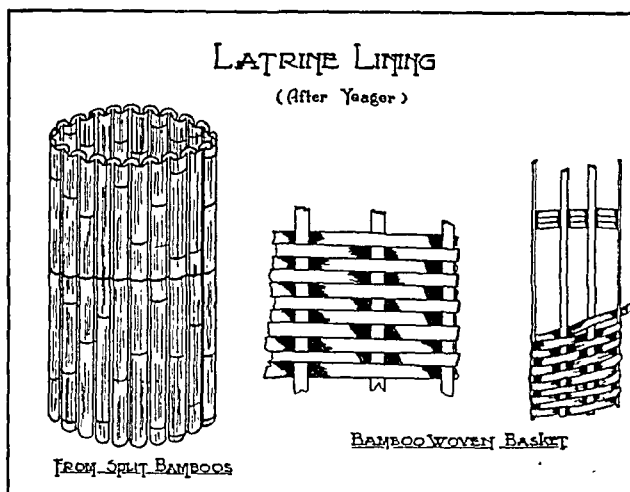


Fig. 1.

*Squatting plates.*—This should be of reinforced concrete. Squatting plates 3 feet by 2 feet 6 inches are made of cement concrete in the following proportions : Cement 1 part, sand 2 parts, stone or brick chips ( $\frac{1}{4}$  inch to  $\frac{1}{2}$  inch) 4 parts.

The thickness of the plate throughout is 2 inches. The plate is sloped  $1\frac{1}{2}$  inches from edges to centre. The concrete is reinforced with  $\frac{1}{4}$ -inch diameter rods (figure 2).

The bare squatting plate with the hole is first cast in a mould. After 24 hours it is removed from the mould and the top surface is smoothed and the foot rests are added.

It should be noted that the face of the hole in the squatting plate is splayed outwards and downwards so as to have the larger area of the hole on the bottom surface of the plate.

Completed slabs should be kept in a cool place immersed under water for a period of ten days when they can be removed and fixed over the latrine.

*Superstructure.*—Any type of superstructure can be constructed. An inexpensive one would consist of side screens of bamboo matting fixed



on to bamboo poles. A type design for a permanent superstructure is shown in figure 3.

9. *Cleaning of tanks and dobas.*—It is necessary to clear weeds in all tanks and dobas and to remove the weeds to a distance. The solid liquid edges have to be cleared of grass.

is almost always inimical to anopheline breeding.

10. *Improvement of cowsheds.*—Living conditions in many places are such that very little can be done in this direction on a general scale. They are very often adjacent to living rooms and

in most cases they form a part of the kitchen with a small bamboo matting partition. There is no ventilation and being very dark provide excellent resting places for mosquitoes.

All that can be done is to provide some simple openings of bamboo framework where this is practicable. Ventilators may also be cheaply constructed by nailing down iron patties (as used in packing boxes) on to a wooden frame. White-washing the walls, where possible, improves matters. The floor is invariably of bare earth and all the urine soaks into it. The remedy is to provide a bedding of dry leaves of banana and other shrubs, waste straw, etc. The urine will soak into it and cowdung can also be easily collected. This bedding is to be removed next morning for composting.

11. *Composting.*—Composting is almost an unexplored field under Bengal conditions. Too much stress therefore must not be laid on this item. The Indore method is too complicated and cannot be advocated for the mass. The Bangalore method seems to be a good one and is undoubtedly simple and may therefore be advocated.

Dry banana leaves, shrubs, water hyacinth, pistia or other vegetation removed from tanks, and straw are provided

as a bedding in the cattleshed for collection of urine and cowdung. An emulsion is made of cowdung in water. A trench is dug 4 feet wide by 4 feet deep by any suitable length. The bedding removed from the cattleshed together

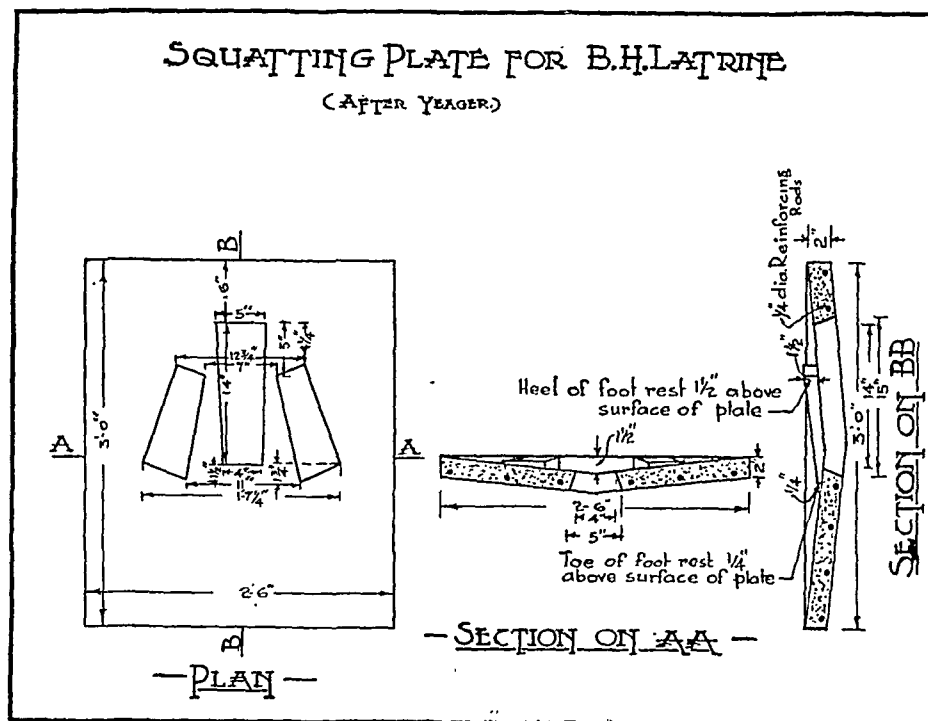


Fig. 2.

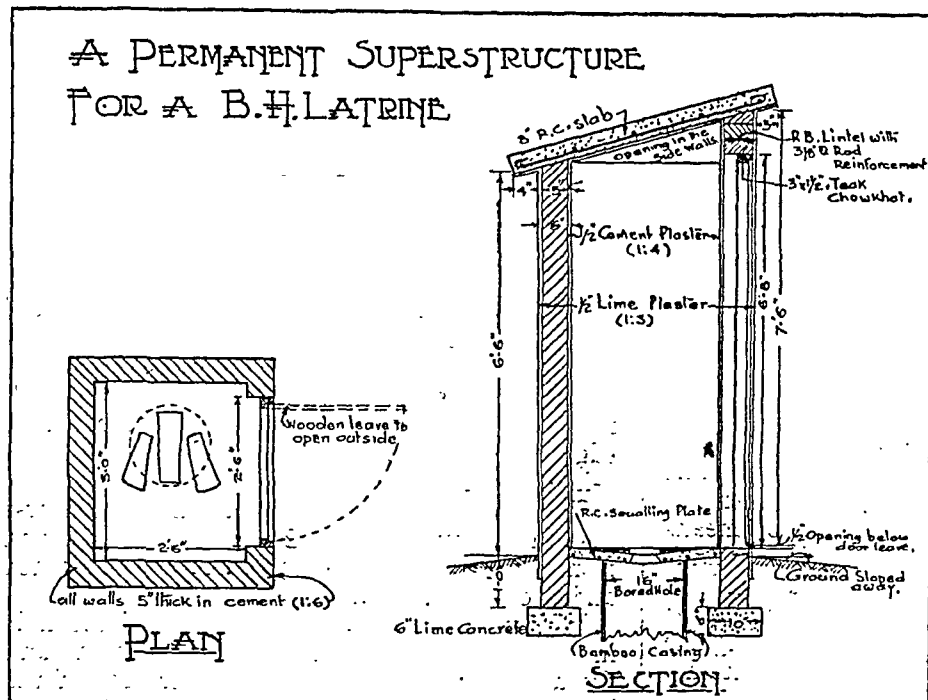


Fig. 3.

The banks and edges should be cleared so that they become approachable during the rains for purposes of anti-malaria treatment. Where there is lemma it should not be removed but its growth encouraged. A complete cover of lemma

with other refuse and garbage is to be utilized for composting. First a layer of refuse 2-inch thick is spread on the floor of the pit. This is thoroughly impregnated with cowdung emulsion. Then another layer of refuse is put on it and impregnated with cowdung. In this way the pit is to be filled up within 6 days. On the seventh day the pit is covered up with earth and allowed to decompose anaerobically. No further attention is necessary and the compost would be ready for use as manure after three months.

### *Summary of programme*

1. Protection of existing tube-wells by providing masonry platforms and drains to remove waste water to at least 20 feet away from the tube-well.

2. Simple repairs to tube-wells, like changing of leather buckets, washers, bolts and nuts. This can be arranged as a demonstration by tube-well mistries or sanitary inspectors to educate the villagers so that some of them may themselves be able to carry out such minor repairs in the future.

3. Chlorination of all open wells and provision of covers.

4. Reservation of tanks for community purposes :—

- (a) Water for kitchen.
- (b) Washing and bathing.
- (c) Cattle washing.

5. Where tanks are the sources of drinking water supply, provision of reserved tanks for such purpose. Clearing the weeds, clearing the banks of all shrubs and trees, raising the banks so that no surface water can get into it, provision of bamboo fencing all round if possible, and finally chlorinating the water and not allowing it to be used for any other purpose than for supply of drinking water.

6. Digging of village drains.

7. Provision of kitchen gardens to be watered by sullage water.

8. Provision of soakage pits (6 feet deep by 4 feet diameter) filled with broken *jhama* (over-burnt brick) chips (graded size 2 inches at bottom to  $\frac{1}{2}$  inch on top) for disposal of sullage water or use as soakage pit urinal. One pit may serve four houses for disposal of sullage water.

9. Bored-hole latrines at selected sites only, and in localities where augers are available from the Health League, Union Board or other local bodies.

10. Clean weeding all tanks and *dobas* and removing the weeds to a distance. The solid liquid edge to be cleared of grass. Cleaning the banks and edges so that they become approachable during the rains for purposes of treatment (for malaria control) if possible. Where there is lemma its growth should be encouraged.

11. Provision of inexpensive openings of bamboo frames in cowsheds and white-washing where possible.

12. Providing a bedding of dry banana leaves, shrubs and straw in the cattle shed for collection of urine and cowdung.

13. Using the bedding removed from cattle shed together with other refuse for purposes of composting. A trench 4 feet wide by 4 feet deep by any length to be filled up in 6 days with layers of composting material impregnated with cowdung solution. The pit to be filled up with earth covering on the seventh day. It will be ready for use as manure in about 3 months.

### *Conclusion*

In conclusion it must be remembered that the main weapon for this kind of work is persuasion, and as such cent per cent results can never be achieved. A constant watch is essential as otherwise the whole thing soon collapses. '*Time rather than money, and continuity rather than perfection*' should be a motto well applicable to public health work in rural areas.

### ANNUAL PUBLIC HEALTH REPORT OF THE PROVINCE OF ASSAM FOR THE YEAR 1940

THE climatic agricultural and economic conditions during the year were on the whole satisfactory. There were deficiency of rain in January and April, and excess during March. The prices of agricultural produce tended to rise. The vital statistics were collected in the same way as in previous years, and their reliability may be taken to be the same. As explained in the report, the ratios for deaths and births have been calculated on the 'estimated population', and the resultant death-rate and birth-rate are 17.20 against 19.25 for 1939 and 28.21 against 28.44 for 1939 for the whole province. The death-rate for infants again decreased, being 141.75 against 149.73 for 1939. The mortality among infants is still heavy, and is due largely to ignorance of mothers, improper feeding and exposure of infants to insanitary surroundings. The need for expansion of child-welfare and maternity work is pressing.

The chief death-causing diseases were fevers, diarrhoea and dysentery, respiratory diseases, cholera, and smallpox. The highest mortality for fevers, which include malaria, kala-azar, and other diseases having fever as a predominant symptom, was recorded in Goalpara, and the lowest in Kamrup. As in previous years quinine and cinchona febrifuge were distributed free to indigent malaria patients throughout the province. The method of diagnosis and treatment for kala-azar was the same as in the previous year. The number of deaths was more by 198, and the number of patients treated by 3,393. The incidence of kala-azar, as a result of survey work, was found to be higher than in the previous year. An indoor hospital with 50 beds was built at Golaghat for serious bed-ridden and complicated cases, and two new public health dispensaries were opened during the year under report. Government have noted with interest the suggestions of the Director of Public Health with regard to further preventive measures and it is hoped that experiments for controlling the suspected vector of the disease may be carried out.

The figure for deaths from typhoid fever is shown as 60, including 12 for Barpeta and 8 for Dibrugarh. The disease is difficult to diagnose, and statistics may not be reliable. Contaminated water-supply and insanitary towns must contribute to the prevalence of the disease, and Government would again draw the attention of municipalities that have failed to provide uncontaminated sources of water-supply or have

otherwise paid insufficient attention to sanitary measures, to their responsibility in the matter.

The reported figure for deaths from cholera was 2,809 against 3,020 in 1939. There was no serious epidemic in any district. Intensive preventive inoculation has been carried out since 1938 with the aim of protecting persons in infected or threatened villages. The number of inoculations carried out in 1940 was 335,559 against 113,727 in 1939, but it appears that further investigation is required before judging the success of the preventive measures.

The reported deaths from dysentery and diarrhoea was 8,964 against 11,641 in the previous year, and for deaths from smallpox 1,400 against 2,197.

Lepers treated in leper asylums and other centres under the medical and public health departments numbered 4,227. A special leprosy officer was appointed and trained during the year. He is now engaged in a survey with a view to devising better organization for preventing the spread of leprosy. Propaganda was carried on with magic-lantern demonstrations by public health officers as before.

**Tuberculosis.**—The chest clinic at Shillong worked with increasing popularity. The number of patients treated was 206 against 132 in 1939. An x-ray plant installed in November, greatly increased the usefulness of the clinic. It is noted that the honorary work of three private medical practitioners has greatly assisted its success, and Government hope that this clinic and the help received will serve as examples in other districts, where the organization of tuberculosis work,

under the Tuberculosis Association of Assam, still proceeds slowly. In the present year, arrangements are being made for considerable improvement in the facilities for treatment in Shillong.

**Food adulteration.**—The working of the Assam Pure Food Act is still not satisfactory, and Government have urged on the authorities concerned the necessity for taking up the matter energetically and seriously. Government agree with the Director of Public Health that it is not lack of staffs or the amount of the fees charged for examination of samples that stand in the way of improvement, and trust that the local bodies will be more vigilant in checking adulteration.

**Maternity and child welfare.**—Trained staff is lacking and there is no recognized institution for the training of midwives in the province. Maternity and child-welfare work continued to be carried on mainly under the Red Cross Society. Government note with appreciation that the welfare centres at Shillong, Sylhet and Nowgong continued to do good work, that there was increased interest in the Goalpara District, and that the Cachar centre has earned special praise from the Director of Public Health. The Shillong Municipal Board made liberal grants for the upkeep of the Shillong centre. The Siva-Sundari Narishikhasram provided a course of training for *dhais* in accordance with the regulations of the Victoria Memorial Scholarship Fund, New Delhi. It is hoped that a Bill for the registration of nurses and midwives will be passed in the near future and that Government will be able to extend facilities for training.

## Current Topics

### Treatment of Haemorrhage from Dental Sockets

By J. D. CAMBROOK, M.R.C.S., L.R.C.P., L.D.S.

(From the *Medical Press and Circular*, Vol. CCVI, 6th August, 1941, p. 120)

THE vast majority of teeth are extracted without mishap, but when hæmorrhage occurs, the importance of correct diagnosis and a definite plan of treatment is essential. It may vary from a slight ooze to a profuse hæmorrhage, and it may be easily controlled or very resistant to treatment. It occurs at all ages and more often in multi-rooted teeth, owing to greater trauma in extraction.

Immediate hæmorrhage is normal, but in cases complicated by factors interfering with coagulation this passes into the intermediate stage. Intermediate hæmorrhage arises within the first 24 hours, and is commonly the result of a local rise in blood pressure due to alcohol, activity, lying down or the diminution of the astringent action of the adrenalin in the local anæsthetic used. Secondary hæmorrhage takes place after 24 hours and is due to sepsis, unless it is a continuation of the intermediate stage.

The history is of importance and the time and difficulty of extraction should be elicited. Enquiry should also be made as to any previous hæmorrhage from tooth sockets and its course and treatment. The extent of bleeding from cuts and abrasions can be verified as a guide to the general condition.

For examination of the mouth, the patient should sit in such a position that a good light can be directed into it. All clot should be removed, including that protruding from the socket. If the escape of blood from the socket can be prevented in any way, clotting normally occurs and may be strong enough to prevent further hæmorrhage. With this end in view, a plain tampon of cotton wool is made and inserted over the socket and bitten upon for five minutes. If the patient is averse to biting, a four-tailed bandage may be used to ensure that there is some pressure. When tying the bandage,

the presence of paper between it and the hair will prevent entanglement. The clots may now be examined to see if they appear fragile, as happens in blood diseases. After the prescribed interval, the cotton-wool is removed and the socket examined. If the flow has been diminished, it is well worth trying the effect of further tampons left in for a longer time. Small degrees of hæmorrhage and lacerations can be stopped in this manner and the temporary arrest of the bleeding by the pressure of the cotton-wool allows clotting to occur. In cases where there is no diminution in the flow, the socket should be inspected to see if the blood is coming from the gum or the depths of the socket. To do this satisfactorily, the clot is removed with curved dressing forceps. When the blood comes from the gum it will be necessary to insert a stitch to bring the edges of the sockets together, and for this a curved non-cutting needle and horse-hair are necessary. It requires some dexterity to insert a needle through the gum without catching on the bone, and as cutting needles cut through the gum, a plain needle is usually used. Horse-hair is much easier to remove subsequently, as the black colour shows up well against blood and decolorized blood clot. After the stitch has been tied, another tampon is inserted and subjected to pressure. Cases in which bleeding continues are due usually to the stitch being ill-placed or not being tied tightly enough. The actual cautery may be of use when there is bleeding from the gum edge, but there are few cases where it can be conveniently used.

When the blood arises from the depths of the socket and pressure upon a pad does not control the flow, then the socket requires to be plugged. Normally, a plug should aim at occluding the socket, never dilating it. To ensure this, a piece of cotton-wool is fashioned into the shape of a mushroom with a short stem, and the head broader than the socket. This is soaked in the chosen medicament and inserted over the dried socket with its stem into it. Pressure from a tampon causes the medicament to ooze from the stem and mix with the blood. A plug should not be pushed down into the depths of the socket unless all attempts at controlling the hæmorrhage fail and in such cases gauze

soaked in a styptic should be used. It should be removed after 24 hours for fear of sepsis. If the socket is plugged deeply with cotton-wool, its entire removal is not easy in view of the clot, and any left behind causes future pain and suppuration. For preference I use Stypven as the medicament, but with one modification. The package of Stypven contains two bottles, one of liquid and the other crystals to be dissolved in the liquid. If the solution of venom is hot, its power is greatly increased although only of short duration, and as its use is greatest in the first few minutes I always use it heated. The bottle of solution is inserted into boiling water for a few minutes, then the contents are added to the crystals. The previously prepared plug is dipped into the solution after the crystals have dissolved and quickly transferred to the dried socket. A tampon is inserted over it, making sure the plug still covers the periphery of the socket, and held in place for 15 minutes. After that time the mouth is inspected to see if blood is soaking the tampon, and if apparently controlled, the tampon is removed, taking great care not to disturb the plug. If bleeding recurs, a fresh plug is inserted combined with pressure. If however it is lessened, it can be assumed that, combined with general treatment, the hæmorrhage will gradually cease. Another hæmostatic which is useful is oil of turpentine, but although antiseptic it has a very unpleasant taste. Other methods that have been of value are the use of hydrogen peroxide, adrenalin, ferric perchloride, but they are not without disadvantages. Whilst the primary object is the control of the hæmorrhage, any method which predisposes to a septic socket will often cause bleeding later. The plug should be gently removed after 24 hours, and if there is further hæmorrhage another should be inserted. It should not be left *in situ* longer, for fear of sepsis, and the most serious cases I have seen have all been from septic sockets.

Where there is a steady ooze that is difficult to control and it is necessary to give the patient some respite, even of a temporary nature, adrenalin may be injected. Up to 5 minims injected very slowly into the gum near the site of bleeding will often cause enough vasoconstriction to arrest the hæmorrhage. It has the great disadvantage that it does cause some local tissue damage and is of a transient nature, but in a few cases the cessation of the flow enables the blood to form a clot sufficiently strong to hold back further bleeding. The promotion of such a clot may also be facilitated by using Stypven in a syringe. It is used warm, the needle being passed gently into the socket at the bleeding point and the venom expressed so as to mix with the blood. A quickly inserted tampon combined with pressure will hold the mixture of blood and venom there. In the laboratory, the addition of Stypven to blood will cause a very strong clot to form and the tooth socket should be able to replace the test-tube.

The general treatment is of great importance in the control of the hæmorrhage. The patient should be in bed, assuming the sitting posture during the day and having several pillows at night, so as to keep the head as high as possible. Stimulants should not be given and all excitement avoided, the patient being kept as quiet as possible. Diet should be liquid and cold and fed through a bent tube. Morphia gr.  $\frac{1}{4}$  is of great value, as not only does it soothe the patient but its depressant action retards the hæmorrhage. In cases where there has been considerable hæmorrhage or where the hæmoglobin has fallen below 50 per cent, transfusion should be carried out. Fresh blood of the correct group and matched with the blood of the patient is given. One pint of blood raises the hæmoglobin approximately 12 per cent. When there has been bleeding for several days, the mouth gets very foul and should be cleansed. This is done by holding a tampon over the bleeding site and swabbing around the teeth with hot peroxide, getting all debris away. This is followed by the application of iodine to the necks of the teeth.

In certain diseases there is a predisposition to hæmorrhage and these cases are those which cause most worry.

Amongst them must be mentioned obstructive jaundice, purpura, high blood pressure, leukæmia, hæmophilia, scurvy and septic and toxic states. Extraction of teeth should not be carried out unless strictly necessary and after full pathological investigation of the blood and adequate preparation of the mouth. In view of the fact that some hæmorrhage is likely to occur, as much sepsis as possible should be eradicated by the dental surgeon before extraction. The teeth should be scaled and polished, every care being taken that all subgingival tartar is removed. Local treatment of the dried gums and pockets with 25 per cent silver nitrate or deliquescent zinc chloride will considerably reduce any gingivitis present. All stagnation areas must be dealt with. Cavities in the teeth can be filled with temporary fillings, and deep pockets, which cannot be eradicated, are packed with cotton-wool impregnated with a mixture of zinc oxide and oil of cloves. This sets quite hard and not only does it prevent the stagnation of food but it has a very beneficial effect on the gingivitis present. The use of hydrogen peroxide with an equal quantity of warm water as a mouth wash, forcing it between the teeth to remove any particles of food, is of definite value. In short, any method of improving oral hygiene and curing gingivitis is to be recommended. The adequate preparation of the mouth cannot be stressed too greatly.

The pathological investigations required are blood and platelet counts, group, hæmoglobin and clotting and bleeding times against a normal control. A tourniquet test for capillary fragility is done at the same time. Cases which show a prolonged clotting time should have a prothrombin estimation to see if there is any deficiency present. In all the conditions mentioned, with the exception of raised blood pressure, there is usually some alteration in the blood picture. Obstructive jaundice shows a prolonged coagulation time with a low prothrombin whilst purpura has a prolonged bleeding time with a diminution in the number of platelets and a positive tourniquet test. Leukæmia gives a characteristic blood picture, and it is suggested that in this condition the liability of hæmorrhage is due to the degree of anæmia present causing local damage. Hæmophilia has a marked increase in coagulation time but it must be remembered that in this disease there are negative phases when it is very nearly normal. Therefore, when extraction is contemplated, too great a reliance must not be placed on a short coagulation time but rather it should be done immediately before the proposed time of extraction. Scurvy shows a positive tourniquet test owing to changes in the walls of the capillaries, whilst in septic or toxic states the platelet count is reduced and both the clotting and bleeding times may be increased.

These pathological investigations, combined with the clinical picture, are of the utmost value in prognosis and treatment. They may indicate the very grave risk of tooth extraction unless better conditions prevail. Apart from the general treatment of the patient, there are certain measures which can be taken to improve the deficiencies of the blood. Transfusion of fresh blood when the hæmoglobin is below 50 per cent, has already been mentioned but it has other uses than raising this level. It decreases the clotting and bleeding times and increases the platelet count when these are abnormal and also acts generally as a stimulant to the hæmopoietic system. When used in cases of blood disorder, it should preferably be of the same group as that of the patient. The hæmoglobin may also be raised by other methods of choice when circumstances permit. When the prothrombin is decreased, this may be restored by the injection of vitamin K. The dose should be determined by the level of the prothrombin, and one of the proprietary preparations, five milligrams daily, should be injected until normality is reached. In cases critically ill, the dosage may be increased several times as no untoward effects have been observed. It should be remembered, however, that vitamin K is without effect on blood clotting times that are abnormal owing to causes other than hypoprothrombinæmia. The use of ascorbic acid in scurvy is well known and

in proved cases 1,200 milligrams daily over a period of four days is quite adequate.

In these cases predisposed to hæmorrhage, the extraction of a test tooth is often of value. There are so many factors influencing the prognosis that the removal of one tooth under optimum conditions can be of great value. Usually a front tooth is chosen because of the small diameter of the socket and its accessibility. After all preoperative treatment has been satisfactorily carried out, the tooth is taken out under local anæsthesia. If possible this should be a nerve block to obviate the local trauma of the injection of a fluid into the tissues. Stypven may be mixed with the blood in the socket and a Stypven plug inserted and covered with a tampon. The subsequent course and necessary treatment will give valuable information for the purpose of future extractions.

#### SUMMARY

(1) Methods of local treatment for the arrest of hæmorrhage are discussed.

(2) The general treatment is described.

(3) Conditions predisposing to hæmorrhage are reviewed with their pathology.

(4) The preoperative local and general treatment is indicated and the method of carrying out a test extraction.

### Sulphonamide Therapy of Trachoma

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(Abstracted from the *American Journal of Ophthalmology*, Vol. XXIV, p. 174)

THE adoption of sulphonamide derivatives for the treatment of various ocular manifestations has aroused considerable interest and enthusiasm in ophthalmology. Among other infections subjected to experimental study with these drugs, trachoma and, to a less extent, the related inclusion-bearing conjunctivitis have been given repeated trials in various countries. While opinion remains divided as to the actual efficacy of sulphonamide compounds in trachoma, it must be admitted that, by popular impression at least, their therapeutic effectiveness in this condition has been largely accepted. In an earlier investigation in which one of the present writers participated, however, trachoma did not respond so favourably to the action of sulphanilamide as had been anticipated at the outset of the study. Since the publication of these observations, an additional number of reports have appeared for the most part stressing the curative value of sulphanilamide and its related products in trachoma. It has consequently become desirable to re-study this form of treatment with the object of establishing, if possible, an explanation for the discrepant results observed by various investigators. With completion of the study, it seemed a timely opportunity to review thoroughly the pertinent literature for the purpose of critical analysis. The present communication, therefore, will serve primarily as a report of the experiments conducted, and secondarily as a critic of the publications appearing up to the time of writing.

#### METHODS OF STUDY

The bulk of the study was conducted at the Missouri Trachoma Hospital at Rolla, Missouri. The patients, originally 31 in number, were reduced to 26, since the remaining five for one reason or another refused to continue treatment too early in the experiment to be of consequence in the study. They were all native whites, hospitalized during the entire period of observation. Treatment consisted of the oral administration of sulphanilamide, the dosage calculated on the basis of body-weight as recommended by Loe; namely, one-third grain per pound of body-weight for the first 10 days of

treatment, and then one-fourth grain for the following 14 days, the drug being given in three doses, with an equivalent quantity of sodium bicarbonate. No other form of treatment was given, although irrigation with saline and boric acid was carried out each morning. In cases of corneal ulceration, atropine was applied locally as indicated (for example, iritis), a measure which functions not as a curative, but as a palliative.

Detailed clinical examinations were made once a week when visual readings were also determined. Temperatures were taken twice daily, and complete blood counts, including differential and hæmoglobin estimation (by the Sahli method), were made at least once a week and in most patients more frequently. In order to estimate the absorption of sulphanilamide, determinations of the blood concentrations were made once a week or oftener by the method of Marshall and Litchfield. Conjunctival scrapings were examined for the presence of inclusion bodies so that their behaviour during treatment might be ascertained. The frequency of inclusions when present, however, was so low in the patients observed, that the appertaining data appear of little if any value and for that reason they need not be considered in this report.

In addition to the patients treated by oral administration, a group of nine individuals was observed at the Washington University Clinics and a group of three at Rolla under topical applications of 2½ per cent neoprontosil. For the most part, these patients treated themselves and reported for examination at the clinic once a week. The neoprontosil was applied as drops four times a day.

#### TYPES OF PATIENTS SELECTED FOR STUDY

No particular effort was made to select any of the patients for this study. They were accepted as they were admitted to the hospital unless the disease appeared to be inactive and the predominant condition was obviously complicatory and demanded correction by surgical measures. Nevertheless, analysis after the treatment suggested that presentation of the data might be more readily accomplished by a partition of the patients into four clinical groups: first group consisted of seven patients in whom the infection was essentially limited to the lids, either in the form of follicular or papillary hypertrophy or both, and with little more than a beginning pannus without infiltration of the cornea; the second group, six in number, exemplified varying degrees of activity of both lids and cornea; the third group was composed of nine patients with predominant and massive corneal disease, but exhibiting little or no involvement of the conjunctiva: the lids were more or less scarred and inactive, while the cornea varied in intensity of pannus, degree of infiltration, and scarring, but in every case the infection was distinctly active; and the last contained four individuals in whom the disease was not only corneal as in the preceding, but was in a stage of active ulceration. It was not expected that sulphanilamide would replace cicatricial tissue in the group of corneal patients; they were included for study only to determine whether the drug could terminate the activity of the disease.

Of the patients studied, 16 were males and 10 were females; their ages varied from 7 to 63 years, and their symptoms covered a duration of a few months to over 20 years. Thus, the trachoma was of less than one year's standing in five patients: of 1 to 5 years in three, of 6 to 10 years in four, of 11 to 15 years in four, 16 to 20 years in one, and of 20 years or more in eight. A number of the patients had had several admissions to the hospital in the past and their treatment had been extensive and varied, depending upon the predominant condition at the time. It is seen, therefore, that the total group represents a typical cross-section of both patients and disease.

#### RESULTS OF THE TREATMENT WITH SULPHANILAMIDE

It may avoid possible misconception to point out in the beginning the degree of absorption of sulphanilamide in this study. As already stated, the patients received sulphanilamide *per os*, one-third grain of the drug per pound of body-weight for the first ten days

of treatment. During this interval, the blood concentration of the drug ran close to 4 mg., plus or minus, per 100 c.c. of blood. With reduction of the drug to one-quarter grain per pound of body-weight over the next 14 days, the blood level dropped proportionately and the determinations during this period revealed blood concentrations varying between 2.0 and 2.5 mg. per 100 c.c. of blood. It was observed, moreover, that withdrawal of the drug caused a rapid decrease of the blood level, so that, in general, the drug was completely or almost completely eliminated within 24 hours. Irrespective, however, of the type of trachoma, practically all patients undergo a rapid amelioration, as measured by subjective symptoms. Thus, for example, photophobia is minimized, secretion or lachrimation is decreased, and a general feeling of increased comfort is simultaneously noticeable. How much of this improvement, however, is referable to sulphanilamide and how much to the general hospital care instituted is difficult to gauge.

Twenty-six patients with trachoma of different clinical varieties were treated with sulphanilamide *per os*. With termination of the treatment, two were considered asymptomatic or arrested, 11 were regarded as definitely improved but still clinically active, and 13 maintained a more or less stationary clinical condition. In other words, half the patients profited from the administration of sulphanilamide. This proportion is reasonably close to that (60 per cent) observed in the study referred to above.

The patients treated with instillations of neoprontosil, as stated previously, were carried for two to three weeks in this manner. In all there was a definite improvement, not only subjectively but even clinically. The improvement was discernible within a few days and reached a maximum at about the end of the first week. From then on the clinical appearance remained stationary, and it became obvious even after another week or two of continued instillations, that whatever benefit was to be derived from this method had already occurred. Consequently, it became necessary to resort to one or another of the metallic salts, in order to render the patients asymptomatic.

#### TOXICITY OF SULPHANILAMIDE

The potential toxicity of sulphonamide derivatives has been emphasized frequently by a number of workers, so that there is no necessity for reviewing the different manifestations at this time. As a matter of record in this study, however, it seems desirable to summarize briefly the incidence of toxic reactions observed in the present group of patients. In five patients it was necessary to discontinue sulphanilamide because of its deleterious effects; in one, the red-cell count dropped progressively from 4,210,000 to 3,000,000, with the haemoglobin value decreasing from 78 to 68 per cent during nine days of treatment—bovine was administered and it required a week before a count of 4,000,000 cells per c.mm. was attained; a second patient was dropped after 13 days because of severe headache and fever; and in three others, fever, cyanosis and nausea had become troublesome, necessitating cessation of sulphanilamide on the 9th, 10th and 13th days, respectively. Other toxic manifestations not sufficient to stop treatment were: fever, 15 patients, in only three of whom, however, the temperature reached above 100°F.; headache in four; marked cyanosis in three; and gastric disturbances in five. Only seven individuals apparently suffered no untoward reaction at all to the drug. Except for the patient mentioned, no marked effect was found on the blood cells, although several individuals showed a gradual diminution in the number of red cells. Toxic reactions to sulphanilamide are relatively mild and negligible; in no case need they be dangerous, since sufficient warning to withdraw sulphanilamide is provided by one sign or another.

#### REVIEW OF COLLATERAL LITERATURE

If an estimate is made of the 36 publications it is seen that of the 11 reporting successful results following drug treatment alone three can be accepted as actually supporting their conclusions with appropriate

evidence. Five additional publications likewise report success, but the evidence is rendered doubtful by supplementary treatment with local agents. This is, therefore, a small proportion of papers justifying the opinion of the therapeutic effectiveness of sulphonamide drugs. If, on the other hand, improvement rather than 'recovery' is taken as an index of efficacy, all but three of the 36 reports are in accord. It would seem, therefore, that the sulphonamide compounds may serve a beneficial purpose in trachoma if supplemented by one or more of the orthodox topical treatments. In fact, this procedure has been employed by several workers as already referred to above.

#### DISCUSSION

That adequate dosage is of paramount importance in the chemotherapeutics of infections is a precept formulated from repeated experience. In addition, it has become more or less axiomatic that wherever feasible the employment of large dosages over short periods is preferable to the employment of small dosages over prolonged periods. The reason for the preference is that, firstly, whatever destructive capacity the drug possesses may be exerted at once, and, secondly, by shortening the duration of treatment, there is less likelihood of the infectious agents becoming adapted or 'fast' to the particular drug.

A study of the dosages adopted by the different investigators reporting successful results from sulphonamide treatment of trachoma suggests either a complete apathy to the principles outlined above, or a practically complete intolerance of the virus of trachoma to these derivatives. Thus, the dosages employed vary from 15 grains to 90 grains or more a day, and the duration of treatment extends from a few days to 70 days or more. While variations in dosage and length of treatment are to be anticipated from case to case, differences of 5 to 6 times in daily dosage and 2 to 8 times in duration of treatment (with apparently equally beneficial effects at one or the other extreme) surpass the usual expectations. The few studies made on the blood level attained by the drug reveal variations up to 6 mg. per 100 c.c. of blood, although half this quantity was also reported effective. Moreover, if the blood level may be estimated from the dosages given, these same authors show that a considerably lower concentration as 20 grains per day for an adult is still effective in eliminating the virus of trachoma. It has been, consequently, a difficult matter to decide on proper dosage in this study.

Clinical experience in trachoma suggests that complete recovery in all patients and complete lack of reference in all individuals rendered asymptomatic is an almost impossible achievement. Yet sulphanilamide has apparently done exactly this in two large groups of patients. Even though the patients were Indians (American), and it is admitted that trachoma in Indians does not approximate the severity of the disease seen in native whites (for example, in Missouri, Kentucky, Tennessee, Arkansas, and other states), the record is better than one would expect.

It may be of interest in this connection to point out that recently another worker has reported that of 34 patients treated with sulphanilamide, 21 (62 per cent) suffered recurrences, 11 within six months after the end of treatment, and 10 within seven months to two and a half years. It is of further interest that in the present series of patients studied, one of the two discharged at the end of treatment as asymptomatic returned to the hospital since this report was written with an exacerbation requiring active treatment. The elapsed interval between discharge and recurrence was approximately four months.

The various degrees of improvement observed by the large majority of workers are more or less generally agreed upon, regardless of the drug, the dosage, or the method of administration. There is no doubt that within a few days the patient exhibits subjective improvement and 'feels better'; the disappearance of photophobia, pain, blurred vision, itching and other symptoms, adds to the patient's comfort, vision, and appearance. But this does not mean, of course, that



recovery or inactivation of the virus in the tissues has been effected. One wonders, nevertheless, how much of the improvement is the result of the specified treatment. Experiments conducted in the past by the present writers with various preparations, such as gentian violet, citric acid, yatoconin, quinine ointment, chaulmoogra oil, and other medication, revealed that all induced a measure of improvement, to a greater or less extent; consequently, the impression was unavoidable that the hospitalization, the daily irrigations, and the special treatments experimental patients always receive were unquestionably responsible for an appreciable portion, if not all, of the improvement. Comparison of the treatment described above with the usual treatment with metallic salts, and other means, indicates to the present writers that the patients treated with sulphanilamide would also have improved under the usual form of treatment. And in those cases where grattage was indicated, the results would have been more gratifying.

#### SUMMARY AND CONCLUSIONS

1. A study of sulphonamide therapy in trachoma has been undertaken in the manner described above.
2. Following the administration of sulphanilamide *per os* to 26 patients, the disease in 2 was arrested, 11 were improved, and 13 unchanged at the end of the treatment.
3. Following neoprontosil applied topically, as already outlined, a definite improvement was observed in all of nine patients. All were subsequently given some other form of treatment in order to render them asymptomatic.
4. A review of the correlated literature has been made and the results have been analyzed.
5. A conservative opinion at the present time would be that sulphonamide compounds cause a disappearance of the non-specific (that is, subjective) symptoms of trachoma and an improvement of varying degrees in the clinical condition; evidence of their curative capacity remains to be established.
6. It is the opinion of the present writers that in spite of the improvement, 'recovery' from trachoma is not the rule but the exception.
7. It, therefore, seems the wiser procedure to supplement sulphonamide treatment with one of the more usual forms of local therapy.

### Treatment with Bacteriophage

(From the *British Medical Journal*, Vol. II,  
20th September, 1941, p. 409)

THE American Medical Association, among other valuable services rendered through its journal, sometimes commissions a report by recognized authorities on the status of some form of treatment. Such a report on bacteriophage treatment, by M. D. Eaton and S. Bayne-Jones, appeared in 1934, and at that time we referred editorially to the cautious and, indeed, somewhat sceptical conclusions to which these authors were led. It is now considered that a further review of the position is necessary, and this has been prepared by A. P. Krueger and E. Jane Scribner, whose full and thoroughly documented account of more recent work on bacteriophage is a valuable source of information apart from the conclusions they draw from it. Seven years of further work enable this review to begin with a statement of the nature of bacteriophage, and an analysis of the mechanism of its action and the factors controlling this.

Bacteriophage is not a micro-organism but a protein of high molecular weight formed from a precursor within the bacterial cell. For lysis to take place a concentration of about 100 phage units per cell is necessary. Well-founded calculations enable the concentrations attainable in a lesion by therapeutic use to be assessed, and it immediately becomes clear that even after direct application the lytic threshold is unlikely to be reached. Systemic administration assumes—in so far as therapy is based on any such reasoned assumption at all—a chemotactic affinity of fantastic proportions between

phage and pathogen', an affinity of which in fact there is no evidence. It has been found in animal experiments that phage given intravenously is rapidly removed from the circulation by the reticulo-endothelial system. But apart from loss of activity by dilution and sequestration, phage applied in any way to a bodily lesion has to operate in a medium immeasurably less favourable than a tube of culture medium. Its activity is known to be greatly impaired by the presence of dead bacteria, which adsorb it irreversibly, by leucocytes and leucocytic extracts, and by serum. These are exactly the materials of which an inflammatory exudate is composed. Thus local circumstances in the diseased tissue are 'practically without exception inimical to the process of bacteriophagy'. Hence it is concluded that however phage preparations may act in the body—and it is not denied that sometimes they may act—lysis of bacteria as seen *in vitro* is not the mechanism. The accepted theoretical basis of phage treatment is thus fallacious. It is also deliberately concluded that the spontaneous development of phage plays no part in natural recovery—a most important decision, setting aside an attractive hypothesis which has captivated popular medical imagination in connection with several diseases.

What, then, are the other effects which phage treatment may produce? There is another possibility involving a direct action on micro-organisms—namely, that in the presence of phage bacterial dissociation may occur, leading to the production of less virulent variants. That this may happen *in vitro* is known; to what extent it occurs in the body is doubtful, and an opposite effect—the production of variants of greater virulence—is a possibility of which at least one example is said to have been observed *in vitro*. There is also evidence of several kinds that phage may act as a stimulus to phagocytosis. The other effects which phage preparations undoubtedly may have all depend on impurities. The preparation is a lysed bacterial culture, and therefore contains, as well as phage itself, constituents of the bacterial cell in solution, any products of bacterial growth, and the remaining constituents of the culture medium. The intravenous injection of such a hotch-potch of materials has an entirely non-specific action in inducing a leucocytosis, and perhaps in stimulating the mechanism of resistance in other unspecified ways. But the preparation also contains the antigens of lysed bacteria, and these are calculated to excite the formation of specific antibodies. It is quite possible that bacterial antigens in this form have a more rapid and perhaps even a greater immunizing power than a suspension of the intact bacteria from which they are derived—that phage is in fact merely a means for producing a more efficient bacterial vaccine. Each of these arguments applies not only to systemic administration but to local application. Whatever view may be taken about local immunity in Besredka's sense, there is no doubt that applications of this sort to the tissues cause a reaction which is protective against infection, if only by causing leucocytic infiltration. In these authors' opinion 'phage lysates in general should be agents *par excellence* for developing local immunity, since they contain several of the individual materials known to be active in this direction; it is our opinion that much of their therapeutic efficiency can be ascribed to this mechanism'.

The second part of their paper is devoted to an assessment of clinical results in various conditions: here the plain facts of experimental study are exchanged for a maze of varied observations strongly coloured with therapeutic enthusiasm, forming altogether a prodigious haystack in which to seek the needle of truth. Its main subdivisions are intestinal diseases, infections of the urinary tract, superficial or local septic infections, and septicæmia. It would be neither feasible nor profitable to review in any detail the conclusions reached on this aspect of the subject. They are in any case mainly indefinite; nothing more can be said, taking reported results as a whole, than that they are suggestive of good effect. The disease for which the evidence of this is clearest is thought to be cholera. Here it

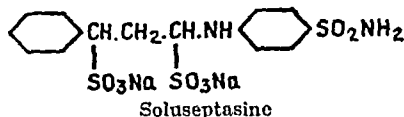
should of course be remembered that conditions in the bowel are relatively free from those obstacles to phage action which are combined in concentrated form in pus. It is granted that there is clinical evidence of the immunizing and other actions by phage preparations which have already been set down as theoretically to be expected, but questioned whether these preparations excel or even necessarily equal products more specifically designed for the purpose, such as staphylococcus vaccine or toxoid and typhoid vaccine. Though it is often argued that phage preparations are at all events harmless, this is not entirely true: severe reactions have been seen which can be attributed to the presence in them of bacterial toxins or of the Duran-Reynolds spreading factor. The whole of this admirable survey should have a healthy effect in a sphere of therapeutics which cries out for clearer thinking and more judicial study.

### The Common Sulphonamides: Nomenclature, Structure and Uses.

By D. G. ARDLEY, M.P.S.

(From the *Lancet*, Vol. II, 22nd November, 1941, p. 625)

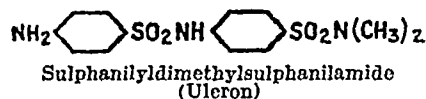
WITH the inevitable increase in the number of compounds introduced into clinical practice for the chemotherapy of bacterial infections the need of an accurate and uniform nomenclature becomes urgent. Few modern British books on general medicine or the specialities make any attempt to achieve accuracy in the names used for these compounds, and the medical journals and encyclopaedias tend to pander to the whims of their contributors instead of exerting strict control over the names employed. As a consequence, for example, all the names which happen to have been employed for the same chemical compound by various contributors to a textbook may appear in different parts of the index. Abstracts of articles from foreign journals often use for drugs names which are unfamiliar to readers in this country and in this way the chief point of the abstract may be lost. Conversely, proprietary names and erroneous nomenclature in English articles duly find their way into foreign abstracts to the mystification of readers. The practitioner who writes a



prescription for 'sulphonamide',  $\frac{1}{2}$  gramme tablets, or the surgeon who orders a wound to be dressed with sulphonamide powder, does not realize that what he has ordered is meaningless. The writer of an article who describes the treatment of a patient with 'Prontosil' given by mouth in such and such a dosage overlooks the fact that there are three distinct chemical compounds to which this name is applied, and that all are given by mouth. The limit appears to have been reached by the author of an article on the use of various sulphonamide compounds who calmly announced at the outset that a particular brand name for sulphanilamide would be used to describe all the different compounds employed! It therefore seems opportune to suggest a few rules for general guidance. First, about dosage. The common practice of describing oral dosage in terms of number of tablets or volume of a suspension is inadvisable. A discussion once arose concerning an article on the treatment of gonorrhoea in which the dosage of sulphanilamide employed was in dispute until it was realized that the author was expressing dosage in drachms of a proprietary suspension. Dosage should always be expressed in terms of the active ingredient.

Most of the sulphonamides in common use have three kinds of name—a chemical name often occupying a line of print, a scientific synonym or pet-name, being the

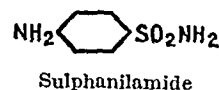
chemical name in a shortened form, and a various number of trade names. The synonym is the one intended for use in scientific articles, but unfortunately not all the compounds have one, and in some cases the trade name is at present unavoidable. Whenever possible only the full chemical name or its shortened form



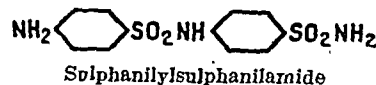
should be used, though it may sometimes be convenient to indicate once in an article which particular brand was employed.

#### SULPHANILAMIDE AND ITS EARLIER DERIVATIVES

Para-aminobenzenesulphonamide or para-amino-phenylsulphonamide is the simplest and most widely



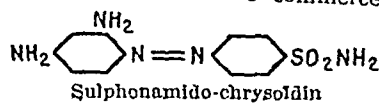
used of these drugs, and being the amide of sulphanilic



acid the name now commonly adopted of sulphanilamide is at once both accurate and brief, and the employment of proprietary names for this compound in medical literature is inexcusable. Of the forty or so trade names indicating proprietary brands of this compound the commonest ones in this country are Colsulanyde, Prontosil album and Streptocide, and sometimes the non-proprietary designations sulphonamide-P or P.A.B.S. are used. A proprietary brand much used in America is known as Prontylin. Some clinicians still do not realize that these names all stand for the same substance, and it is not unusual to hear of a patient's treatment being changed from one make of sulphanilamide to another, because he did not respond to the brand first ordered. Many other proprietary names for sulphanilamide, less commonly used than the four already given, are encountered, chiefly in foreign medical literature. In the case of a few trade names encountered in foreign medical journals there has been no clue to the composition of the drug, or the composition has been variously described in different articles so that it has been impossible to be certain what the compound was. Sulphanilamide was included in the Fourth Addendum to the B.P. 1932.

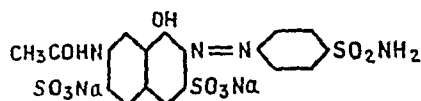
The simplest and most convenient classification of other sulphonamide drugs is to regard them as derivatives of sulphanilamide and as falling into two groups according as to whether substitution takes place in the amino ( $\text{NH}_2$ ) or in the amide ( $\text{SO}_2\text{NH}_2$ ) portion of the molecule. All the earlier compounds belong to the first class and are split up with release of sulphanilamide in the body. The more active substances introduced subsequently, such as sulphapyridine and sulphathiazole, fall into the second category, and these compounds do not depend for their action on the production of sulphanilamide.

The first compound to be employed was sulphonamido-chrysoidin, which is 4'-sulphonamido-2:4-diaminoazobenzene, introduced into commerce under the



name prontosil after having been called Steptozon. The name prontosil strictly refers, therefore, to this azo dye-stuff but most English clinicians use it to designate sulphanilamide. If the word is used at all it should never be employed without qualification, so that there is no doubt as to meaning. Sulphonamido-chrysoidin is also known as Prontosil flavum or Prontosil rubrum. A less common trade name is Pronzin

rubrum. A more soluble compound was later introduced for parenteral administration, which consists of a solution of the disodium salt of 4'-sulphonamidobenzene-2-azo-1-hydroxy-7-acetyl-aminonaphthalene-3 : 6-disulphonic acid, usually known in this country as Prontosil

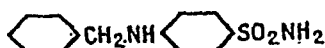


Azosulphamide (Prontosil soluble)

soluble, and sometimes as Prontosil-S or Prontosil II. Occasionally the name prontosil is applied to this compound instead of to sulphonamido-chrysoidin, and in America, where it is given by mouth in place of the latter, it is known under the proprietary name of Neoprontosil, the 'descriptive non-proprietary name' proposed for this substance by the Council on Pharmacy and Chemistry of the American Medical Association being azosulfamide. The name streptozon has been given to both prontosil rubrum and prontosil soluble, the latter having sometimes been distinguished as Streptozon II or S, and curiously enough the designation Prontosil red is sometimes used for prontosil soluble rather than prontosil rubrum. The Rubiazols include the French equivalents of the German azo sulphonamides and rival them in confused terminology. It is, however, sufficient to remember that in this country the name rubiazol is applied to a compound which differs from sulphonamido-chrysoidin in containing a carboxyl (COOH) grouping, and hence is conveniently described as carboxysulphonamido-chrysoidin.

In common with most other compounds of the first group in which substitution takes place in the amino radical of sulphanilamide, these substances owe their activity mainly to the release of sulphanilamide itself in the body tissues, the coloured compounds being split at the azo linkage. Endeavours have been made to show that the azo linkage *per se* may play a rôle in their action, but all the important recent advances concern colourless compounds, and the dye-stuffs cannot but be regarded as being chiefly of historical interest.

Of the sulphanilamide derivatives belonging to the first group which are not dye-stuffs, the most commonly used in England is that formed by substituting one of the hydrogen atoms in the amino group by a benzyl group.



Benzylsulphanilamide

This compound is para-benzylaminobenzene-sulphonamide or benzyl sulphanilamide. It is known in England as Proseptazine or M.&B. 125, and in France as Septazine or 46 R.P. The drug is soluble in water only to the extent of about 1 in 25,000, compared to sulphanilamide which has a solubility of about 1 in 100. The sodium salt of the corresponding succinyl derivative of sulphanilamide—sodium para-succinylaminobenzene-sulphonamide or sodium succinyl sulphanilamide—has been issued for parenteral administration under the name Ambesid soluble. There is also a product Ambesid, and it might reasonably be expected that this would be succinylaminobenzene-sulphonamide itself, but in fact this is another proprietary name for sulphanilamide.

A widely used compound which is much more soluble than sulphanilamide and consequently more suitable for parenteral administration is Soluseptazine or M.&B. 137, known in France as Soluseptazine or 40 R.P. It is disodium-*p*-( $\gamma$ -phenyl-propylamino)-benzene-sulphonamide- $\alpha$ - $\gamma$ -disulphonate, the sodium sulphonate part of the molecule being the solubilizing groups. No convenient non-proprietary designation for soluseptazine has come into use.

A soluble sulphanilamide derivative for parenteral administration, and one having a high sulphanilamide content, has recently been placed on the market under the name sulphanilamide L.S.F. It is described as sulphanilamide lactoside sodium formaldehydesulphoxylate. Reference has also been made to a compound

called Sulphonamide E.O.S. and described as the sodium salt of the ethylsulphonic acid of sulphanilamide. It therefore appears to be sodium 4-sulphonamidophenylaminoethane sulphonate. It has been tried clinically in cattle and man. Mutch (1941) has described some investigations on its pharmacology and activity and has given details of its use in 34 cases of cerebro-spinal fever.

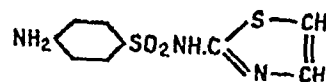
#### LATER DERIVATIVES

The first drugs of the second class were three disulphanilamide compounds, known originally as Diseptal A, B and C, and introduced from Germany. Of these the first, and the only one to come into use in England, is known as Diseptal or Uleron. It is also called Uliron, Ulirone, D.B. 90 or D.B. 373, and is para-aminobenzene sulphonamido-benzenesulphondimethylamide or sulphanilyldimethylsulphanilamide. Diseptal B is the corresponding monomethyl derivative, and is now referred to in German medical literature as Neo-Uliron. Diseptal C contains no methyl groups, being sulphanilylsulphanilamide. Sulphanilylsulphanilamide is available in America and on the Continent under the name Disulon, where it is used in the treatment of gonorrhoea. It is also known as 'disulphanilamide', a name which, unfortunately, has also been used for the dimethyl derivative (uleron). Claims that uleron is valuable for the treatment of gonococcal, staphylococcal and anaerobic infections have not been substantiated, and the subsequent use of sulphapyridine for the treatment of gonorrhoea and the activity of sulphathiazole in staphylococcal infections have led to its falling into disuse. In common with most other derivatives of the second class uleron is not broken down with the release of sulphanilamide but is eliminated partly unchanged and partly in a conjugated form.



Acetyl sulphanilamide

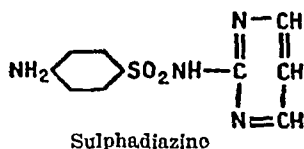
An event of outstanding importance in chemotherapy was the introduction of the compound derived from sulphanilamide by substitution of one hydrogen atom in the amide portion of the molecule by a basic pyridine group, giving 2-(*p*-aminobenzenesulphonamido) pyridine. This was first known as T. 693, later introduced as M.&B. 693 and subsequently called Dagenan, a mutation on an Essex place name. To a non-chemist sulphanilylaminopyridine should not be too long to remember but the Americans christened the compound sulphapyridine, which name, although not accurately descriptive chemically, has been generally accepted. Sulphapyridine proved to have a much higher degree of activity than sulphanilamide, thereby extending the range of chemotherapy far beyond infections by sulphonamide-susceptible strains of streptococci. Pneumococcal infections were brought under control, a more potent weapon against gonococcal, meningococcal and gas-gangrene infections provided, and the effective chemotherapy of plague and staphylococcal infections brought nearer. A calcium compound of sulphapyridine has been placed on the market in Germany under the trade name Orsulon. It is issued in tablets for oral administration in the treatment of pneumococcal and other infections. In Stockholm a compound of sulphapyridine and salicylic acid, known as salicylazosulphapyridin, and marketed as Salazopyrin, has been used with success in rheumatoid arthritis and ulcerative colitis.



Sulphathiazole

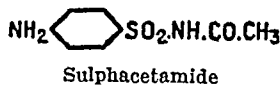
An even more active compound than sulphapyridine is the corresponding thiazole derivative 2-(*p*-aminobenzenesulphonamido) thiazole or 2-sulphanilylaminothiazole, usually called sulphathiazole, and also known in England as Thiazamide or M.&B. 760, in Switzerland as Cibazol or Ciba 3714, and in France as R.P. 2090.

It has proved its value in the treatment of infections with *Staphylococcus aureus*, some of the clostridia, *Pasteurella pestis*, and various organisms found in urinary-tract infections, including *Streptococcus faecalis*. Various compounds obtained by replacing one of the hydrogen atoms in the thiazole ring have been tried in therapeutics, and of these the name sulphamethylthiazole indicates the 4-methyl derivative—namely, 2-(*p*-aminobenzenesulphonamido)-4-methylthiazole, or 2-sulphanilyl-amino-4-methylthiazole (M.&B. 838). Owing to the danger of peripheral neuropathy from the use of these derivatives (*cf.* uleron which also contains methyl groups), and their greater liability to deposit crystals in the urinary tract compared to sulphathiazole itself, little more is likely to be heard of them.

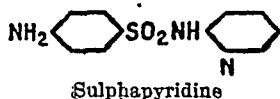


Another heterocyclic derivative of sulphanilamide, the pyrimidine analogue of sulphapyridine, has recently been introduced in America; this is 2-(*p*-aminobenzene-sulphonamido) pyridine or 2-sulphanilyl-amino-pyrimidine. Sulphadiazine, as it is called, appears from the preliminary studies of American workers such as those of Finland, Strauss, and Peterson (1941) and of Long (1941) and his associates at Johns Hopkins Hospital to have about the same degree of activity as sulphathiazole and sulphapyridine on pneumococci and meningococci, to have an activity on *Staph. aureus*, and to have a high degree of activity on *Klebsiella pneumoniae* (Friedländer's pneumobacillus). It has been tried in pneumococcal pneumonia, cerebro-spinal fever, staphylococcal, streptococcal, gonococcal and other infections but the data at present available concerning its activity, toxicity, absorption, distribution and elimination are inadequate to predict its ultimate place in chemotherapy.

Sulphapyridine and sulphathiazole being of low solubility in water are unsuitable for parenteral administration in solution, for which purpose their sodium salts are employed. The latter being compounds of weak acids with a strong base yield solutions which are highly alkaline. If one of the amide hydrogen atoms of sulphanilamide is replaced by an acetyl radical the compound *p*-aminobenzenesulphonacetamide is formed, which is known as sulphacetamide and was introduced under the proprietary name Albucid. It has been advocated for use in gonorrhoea, for which purpose



it is less effective than sulphapyridine but rather strikingly free from toxic effects, owing probably to its low solubility and consequent poor absorption from the alimentary tract. Its sodium salt differs from the sodium salts of sulphathiazole and sulphapyridine in not yielding a highly alkaline solution. Sodium sulphacetamide is issued as Albucid soluble or Sulphacetamide soluble. It is employed intramuscularly and as a 30 per cent solution for intravenous injection, and a 2.5 per cent solution has been advocated for application to the eyes in the prophylaxis of bacterial infection following injury by vesicant war gases. Albucid and albucid

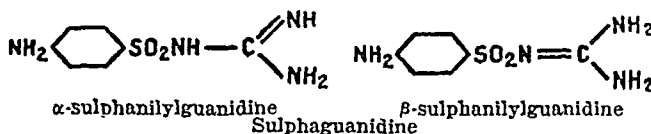


soluble have been placed on the market in Canada under the names Sulamyd and Sulamyd soluble. Sulphacetamide differs from the acetyl derivative of sulphanilamide, into which the latter is partly converted in the body, since in sulphacetamide it is a hydrogen of the amide group which is replaced by the acetyl

radical, whereas with acetyl sulphanilamide substitution takes place in the amino group. Analogous conjugation takes place with sulphapyridine, sulphathiazole, sulphadiazine and a number of other sulphonamide drugs. Unlike these compounds sulphacetamide appears to be partly broken down in the body to sulphanilamide.

#### CHEMOTHERAPY INSIDE THE BOWEL

The absorption of a sulphonamide from the alimentary tract or from a wound chiefly depends on its solubility in water at body temperature. Thus the solubility and absorbability of sulphanilamide, sulphathiazole and sulphapyridine decrease in that order. Other factors, however, have an influence on degree and rate of absorption, and some compounds, much more soluble than sulphapyridine or sulphathiazole, have a low degree of gastro-intestinal absorption. The idea arose, therefore, of using a sulphonamide which is bacteriostatically active, fairly water-soluble and of low absorbability to combat infections which are largely confined to the alimentary canal. Marshall, Bratton, White and Litchfield (1940), who studied various compounds from this point of view, found that sodium sulphanilyl sulphanilate, *N*-(2-hydroxy-ethyl) sulphapyridine, *N*-(2-diglycosulphapyridine and sulphanilyl-guanidine fulfilled the requirements of water-solubility and limited absorption from the intestine. Since sulphanilylguanidine appeared to be the most active of these compounds against a number of pathogens it was selected for pharmacological and therapeutic investigation. (It may be recalled that sodium sulphanilyl sulphanilate once achieved a short-lived but world-wide interest for a supposed activity in virus infections.)



Sulphanilylguanidine is *p*-amino-*N*-guanyl-benzene-sulphonamide. Marshall and his colleagues suggest that the formulæ may both be considered correct for the compound as they are probably resonance isomers, easily transformed one into the other.

The blood levels reached after the administration of sulphanilylguanidine are low as a consequence of its limited absorption, and the concentration in the gastro-intestinal tract is correspondingly high. It is suggested for trial in bacterial infections which are chiefly localized in the intestines, such as bacillary dysentery, cholera and the early stages of the enteric fevers, and for reducing the hazards of intestinal surgery. In acute bacillary dysentery it will have to be established that sulphanilylguanidine has advantages over sulphathiazole and sulphapyridine, those 'veritable Excaliburs, with which dysentery apparently may be vanquished without fail' [Ravenel and Smith (1941)]. Other sulphonamides have proved inactive on *Vibrio cholerae* at ordinary therapeutic concentrations but Marshall and others have found sulphanilylguanidine bactericidal *in vitro* in a concentration of 200 mg. per 100 c.c.m., so that at the high levels reached in the gastro-intestinal tract it is possible that the administration of this compound may be of benefit in cholera. Its use in intestinal infections bears some analogy with the use of sulphonamides in infections of the urinary tract, where the concentration in the urine is, of course, enormously greater than in the blood and tissues.

Various sulphonamides have given unquestionable benefit in cases of ulcerative colitis, although the mechanism of the effect must necessarily remain obscure while the ætiology of this condition is unknown, and a few experiences in the use of sulphanilylguanidine in ulcerative colitis are encouraging. The drug is being known as sulphaguanidine, by analogy with sulphapyridine and sulphathiazole.

#### OTHER SULPHUR COMPOUNDS

Not all the sulphur compounds which are active anti-bacterial agents are sulphonamides; a number are sulphones, sulfoxides and sulphides. The sulphones

which have been investigated experimentally as well as clinically, may be regarded as derivatives of 4:4'-diaminodiphenylsulphone. This substance has proved excessively toxic to mice but not to some other laboratory animals, and its toxicity probably precludes its clinical employment in man. McEwen, Pizer and Paterson (1941) have reported the rather unexpected finding that the compound is of relatively low toxicity for cattle, producing no toxic effects in therapeutic doses. The di-acetyl derivative of 4:4'-diaminodiphenylsulphone is of low toxicity and has been used in France for the treatment of gonorrhœa under the proprietary name Radilone (1399 F.). The glucoside of 4:4'-diamino-diphenylsulphone has been studied for its activity in experimental bacterial and virus infections, and has been used clinically in the treatment of cerebrospinal fever, trachoma and lymphogranuloma inguinale. A compound known as Promin and described as the sodium salt of *p,p'*-diamino-diphenyl-sulphone-N,N'-di-dextrose sulphonate has been tried in artificially induced animal infections with various coecal and bacillary organisms, and used clinically by mouth and intravenously. This drug has been found to possess a retarding influence in experimental tuberculous infections of guinea-pigs apparently greater than that conferred by sulphonamides. At present, however, the effective chemotherapy of clinical tuberculous infections remains, with that of brucellosis, and the introduction of virucidal agents, probable achievements of the future. Despite the number of compounds in clinical use and the far greater number which have been studied experimentally, the tremendous strides made during the past few years constitute but the beginning, though a highly successful one, of a new era in therapeutics.

### The Record of a Blood Donor

(From the *Journal of the American Medical Association*, Vol. CXVI, 1st February, 1941, p. 415)

THE value of human blood and plasma for transfusion in certain diseases is now well established; its lack of specific value for other conditions may not be so well known to physicians and to the public. The effects of the injection of non-specific protein and of the materials contained in blood and plasma may be sufficient in themselves to develop non-specific benefits which may cause false impressions of values. This exceedingly brief evaluation of blood transfusion is by way of introduction to a problem created by the drama associated with the donation of human blood for medical purposes. The creation of blood banks and serum centres, and the efforts now being made to secure donation of blood from hundreds of thousands of persons, will in time establish routines which may make such records as that which follows impossible.

In the *Cosmopolitan* magazine for November 1940 appeared an article relative to Mrs. Rose McMullin, who in 1935 apparently permitted herself to be infected with *Staphylococcus aureus* in order that she might develop antibodies. It had been decided to use her blood for transfusion in the case of her niece, who was suffering from an infection with *Staphylococcus aureus*. The physicians in the Hahnemann Hospital in Philadelphia, according to the article, utilized this procedure on her suggestion. They took blood from Mrs. McMullin on several occasions and injected it into the niece. The niece recovered. Then in 1938, it is said, Mrs. McMullin responded to a request for blood to be used for a boy who was dying from *Staphylococcus aureus* infection in Delaware County, Pa. Some time later came an appeal from Chester, Pa. and again Mrs. McMullin responded. By this time apparently she began to be known as the 'golden lady', probably because of the *Staphylococcus aureus* infection. She is also occasionally referred to as 'the darling of the American Legion', since the American Legion is participating in the campaign to secure blood for transfusion for the military services.

According to the article in the *Cosmopolitan* magazine, 'Mrs. McMullin had donated her magical help

free, refusing the usual donor's fee. All she accepted was travelling expenses'. Then Gabriel Heatter put Mrs. McMullin on his programme. From that time requests for her blood began to come in great numbers, not only for cases of *Staphylococcus aureus*, but also for infections with *Streptococcus viridans*, from patients with leukaemia and for other conditions. It would seem, according to the article in the *Cosmopolitan* magazine, that Mrs. McMullin has a heavy file of letters of gratitude from physicians and that 'she has given over 26,000 cubic centimetres of her golden life stream'.

In the files in the headquarters office of the American Medical Association, information has accumulated which must be placed with that in the *Cosmopolitan*. First is a letter from a physician in Johns Hopkins Hospital who inquired about the use of her blood for a case of myeloid leukaemia. In this instance, the doctor writes, the parents of the child had been informed by Mrs. McMullin's agent that she had recovered from leukaemia and that her blood contained the proper neutralizing bodies. It was stated that she would ask no fee but merely \$500 for her expenses. References were given to two physicians who were said to have used her blood for cases of leukaemia, but specific inquiry revealed that the blood had not been of the slightest use in these cases.

Another letter from a physician in Newark indicates that her blood was offered for a case of *Streptococcus viridans* infection, with a request for \$300 to cover expenses. A third letter from a physician in Louisiana concerned a patient with subacute bacterial endocarditis. Next comes a report from a physician in New York, enclosing extended correspondence with Mrs. McMullin, begun because the father of a 6-year-old girl with lymphogenous leukemia asked that a transfusion be made with the blood of Mrs. McMullin. An extended correspondence indicates that Mrs. McMullin did not insist that her blood would help a patient with leukaemia but said she would take a while to build up her blood so that it could be used in that direction. In October 1940 her blood was examined by a New York physician, who found that she had a moderate anaemia; he refused to use her blood until she could get a certificate from her own physician that it would be satisfactory.

Next comes a communication from a physician in Pennsylvania late in December. A farmer's boy in his community had *Streptococcus viridans* infection with subacute bacterial endocarditis. In this instance the Philadelphia *Inquirer*, having learned of the case, telephoned offering the services of Mrs. McMullin, who it seems was at that time in Oklahoma City giving her blood to another patient with *Streptococcus viridans* infection. The physician had difficulty locating Mrs. McMullin and after correspondence discovered that her blood was not of the right type. She was, however, apparently making a series of visits to various communities for the distribution of her blood. A physician from Missouri and another from Alabama who had experiences with Mrs. McMullin wrote that she states she will give her blood just for 'expenses' but that her expense sheets 'would make our national debt pale into pauper figures'.

There comes also at this time a letter from a physician in Missouri who requested that Mrs. McMullin send her serum in a small bottle, having it taken by one of the blood banks in New York. The price asked for these bottles of serum was \$100 per bottle. The amounts which came in these bottles varied from 210 to 51 c.cm. of serum.

In the case of one boy with streptococcal endocarditis, Mrs. McMullin provided enough blood for seven transfusions of approximately 200 c.cm. each over a period of two weeks. When the patient failed to respond, she insisted that the physician discontinue the sulphathiazole. This he did, but the fever went upward again immediately, so the sulphathiazole was again administered, whereupon there occurred an immediate drop in the temperature.



This is the record to date of a widely publicized blood donor. It provides many strange sociological and psychologic facets. The report indicates the need for some type of control over this form of medical activity.

## Methods for the Local Application of Sulphanilamide

By F. HAWKING, D.M.

(From the *British Medical Journal*, Vol. II, 15th November, 1941, p. 685)

EARLIER papers have described the anti-bacterial effects of local applications of the sulphonamides to experimental wounds infected with the organisms of gas gangrene, and the concentrations in the blood and in the tissues around the wound resulting from such local applications. During this experimental work various practical methods have been devised, and these are here described in the hope that they may be helpful to those employing local applications of sulphonamide compounds to human lesions. For the sake of conciseness most references to other workers have been omitted. The compounds used have been either sulphanilamide or sulphathiazole.

### POWDER

In shallow open wounds this is the simplest form in which to apply the substance. It can be distributed by means of a spoon, a pepper-pot, or an insufflator. Whichever method is used, enough powder should be applied to cover the whole surface liberally, and yet not enough to form large concretions, which take a very long time to dissolve. Gently massaging the powder into the tissues with a spatula will help to get it effectively distributed and dissolved. For use in the operating theatre on fresh wounds it is convenient to have a supply of the powder in 5-gramme lots, put up either in paper packets or in screw-capped bottles. In order to obviate the very slight risk of fortuitous contamination of the powder, during its manufacture or afterwards, by tetanus or other spores of pathogenic bacteria, it can be sterilized in such packets or bottles by dry heat at 150°C. for one hour. (If sterilized in the autoclave with the cap unscrewed the powder is apt to become crystalline and is no longer suitable for use in an insufflator.) For routine ward work the use of unsterilized powder would seem to be justifiable.

### GAUZE

In narrow deep sinuses which are packed at regular intervals with ribbon gauze the powder can be inserted into the depths on the packing. This can be done most simply by pouring the powder on to the gauze as it is pushed in, but a better way is to incorporate the powder on to the gauze beforehand. For this purpose small glass pots with a metal screw cap, such as are used for ointments, are taken. A wide slot is cut in the lid. The pot and the gauze are sterilized separately. The gauze is then passed through a thick paste of sulphanilamide and water under sterile precautions and is placed in the pot, the end of the ribbon protruding through the slot. The top of the pot is covered with a piece of sterile oiled silk. For use in the wards the ribbon is pulled out as required. If the gauze is autoclaved after smearing with the paste most of the sulphanilamide forms powdery crystals, which cease to adhere to the ribbon.

### TABLETS

It is difficult to transfer powder to the bottom of a deep sinus. The best method in these cases is the use of small tablets made of the compressed compound—*e.g.*, tablets containing about 0.2 gramme of material and measuring about 8 mm. across. Such tablets were first suggested by Dr. A. S. Parkes; they were kindly prepared by the British Drug Houses Ltd. and May and Baker Ltd. The tablets can easily be inserted into the desired position by sinus forceps, and they are

then crushed to hasten disintegration; eventually they are completely absorbed and leave no residue which might act as a foreign body. With sulphanilamide, which is fairly soluble, tablets of the pure compound will probably be dissolved in a reasonable time, although it is advantageous to crush them in order to accelerate the process. With sulphathiazole, tablets of the pure compound (uncrushed) were found to persist in a sinus for over two days without much visible change. It is better to use tablets consisting of 0.1 gramme of sulphathiazole and 0.1 gramme of glucose, the glucose being added in order to promote the disintegration of the tablet; when these are crushed after insertion most of the material is dissolved in twenty-four hours. Tablets could also be used in a wound when it was desired to secure a steady supply of sulphonamide over a prolonged period; by choosing tablets of an appropriate size the duration of action could be varied as required. The surface of the tablets can be sterilized by dry heat at 85°C. for one hour; heating to 115°C. causes the tablets which contain glucose to turn brown. This degree of sterilization will not kill spores, but the position is the same as that described for the powder.

### PASTES

The results described in this section form the preliminary part of a wider programme, which will be described in more detail when it has been completed. Briefly, the ideal sulphanilamide paste for application to wounds, burns, etc., should have the following properties:—

1. It should be satisfactory pharmaceutically—*i.e.*, stable, non-odorous, non-rancid, etc.
2. Its physical consistency should be suitable for the required purpose; burnt surfaces might require a thinner preparation than that used for plugging wounds.
3. It should comprise only materials which are available under present war conditions. Thus, since cod-liver oil, which forms the base of two of the pastes described below, is now in short supply, a search for a suitable substitute forms part of the wider programme now in progress.
4. Sulphanilamide should be liberated from the paste at the optimum rate. Presumably the concentration of sulphanilamide in the fluid in contact with the paste should be as near saturation as possible, provided that: (a) The concentration is not so high as to injure growing tissues or to paralyse leucocytes. Jacoby, Medawar, and Wilmer found that fibroblasts and macrophages are killed by a saturated solution of sulphanilamide (concentration 1:60), are temporarily depressed by concentrations of 1:150, and are not affected at all by concentrations of less than 1:1,000. According to these findings, it might be advantageous if the paste exerted a slight restraint on the rate of solution of the sulphanilamide. (b) The amount absorbed is not so great as to produce a toxic concentration in the blood; probably this will not occur except when the areas to be dressed are large; it can be decided only by blood estimations of treated patients. (In a private communication Colebrook reports that one patient who was treated by sulphanilamide paste for a very extensive burn became cyanotic, and the concentration of compound in the blood was 8 mg. per 100 ml.) The whole question is under investigation.

It may here be noted that mixtures of sulphanilamide and liquid paraffin appear to be in use in some hospitals. According to experiments in this laboratory sulphanilamide is insoluble in paraffin and cannot diffuse across it. In mixtures of paraffin and sulphanilamide, however, the particles of sulphanilamide usually sink to the bottom of the paraffin layer until they come into contact with the underlying watery fluids, in which they dissolve. Hence, if sulphanilamide suspended in paraffin is injected into rabbits subcutaneously it is absorbed almost as quickly as if it were suspended in saline. This occurs because the mixture is unstable and in the body it separates into its component parts; if this separation were prevented—for example, by using petroleum jelly—little or no absorption would presumably take place.



5. The paste should be non-irritant to the tissues and innocuous to leucocytes. It should not delay healing; rather, if possible, it should stimulate it.

The complete solution of all these problems will take a considerable time, and meanwhile casualties occur which require treatment. Therefore this short description is given of the best pastes which have been found to date so that they may be available in hospitals, and clinical experience may be gained which may help to orientate the further researches in hand. For the pharmaceutical side of the present work I am indebted to the British Drug Houses Ltd., who kindly co-operated with their experience in these matters and devised pastes of different properties for my trial. The physiological action of these pastes was tested by injecting them between the muscles of rabbits and into the peritoneum of rats; the irritation which they caused was not appreciably greater than would have been produced by any foreign body in these positions. Three pastes are provisionally recommended to suit three different types of lesion:—

1. *Sulphanilamide*, 30 per cent; *oleic acid*, 1.4 per cent; *triethanolamine*, 0.35 per cent; *cetyl alcohol* and *beeswax*, each 1.4 per cent; *water* to 100 per cent.—This is a thin paste to spread over inflamed skin surfaces—e.g., impetigo—in order to apply sulphanilamide with as little other material as possible. It can be used on granulation tissue instead of powdered sulphanilamide, but if inserted into deep wounds it leaves a residue. The sulphanilamide is absorbed from this paste almost as rapidly as when the powdered compound is applied as such. This paste was kindly tested by Dr. A. Glucksmann of the Strangeways Laboratories, who applied it every other day to standard wounds in rats. He found that it caused very slight irritation, as shown by stimulation of collagen regeneration and slight retardation of epithelial regeneration; but this irritation was so slight as to be unimportant compared with bacterial infection.

2. *Sulphanilamide*, 30 per cent; *cod-liver oil*, 49 per cent; *oleic acid*, 3.5 per cent; *triethanolamine*, 1.05 per cent; *cetyl alcohol*, *beeswax*, and *other ingredients* to diminish rancidity, 3.5 per cent; *water* to 100 per cent.—This is a paste of medium consistency. The absorption

of sulphanilamide from it proceeds slightly more slowly than that which occurs when the compound is applied as a simple powder. Besides supplying a large depot of sulphanilamide, which will be taken up by any serous exudate to form an almost saturated solution, a paste of this kind provides an oily protective layer and will also prevent sticking of dressings. This paste was designed especially for the treatment of burns. Colebrook (personal communication) has observed the rapid disappearance of hæmolytic streptococci following its use in such injuries: he also found that it is unnecessary to change the dressings more often than every two or three days. Robson and Wallace have reported very satisfactory results in burns treated with a similar paste made up with albucid (*p*-aminobenzenesulphonacetamide), which is considerably more soluble than sulphanilamide and which accordingly may exert a greater effect upon the less sensitive organisms such as staphylococci and *Ps. myocyanea*.

3. *Sulphanilamide*, 30 per cent; *cod-liver oil*, 60 per cent; *beeswax*, 10 per cent.—This is a stiff paste, to be used on gauze for packing wounds, in the same way as vaselined gauze is used. Its consistency can be modified by varying the proportions of cod-liver oil and beeswax. It provides a non-irritant, non-adhesive mechanical support to the sides of the wound, and at the same time gives off a supply of sulphanilamide, liberation of the compound being slow. It tends to become rancid, however, unless preventive measures are taken.

#### SUMMARY

Methods are described for the local application of sulphanilamide: (a) as a powder to open wounds; (b) as tablets or on gauze to deep sinuses; (c) as various kinds of paste to treat inflamed surfaces, burns, and wounds which must be packed.

Details are given of three pastes which may be recommended for use in three different types of lesion.

Acknowledgments are due to Colonel L. Colebrook for inspiration and advice; to the surgical staff of the New End Hospital, Hampstead, for facilities; to Miss M. Kuck for technical assistance; and to the British Drug Houses Ltd. for co-operation in devising and preparing the pastes.

## Reviews

**HANDBOOK FOR MIDWIVES AND MATERNITY NURSES.**—By Mary Mayes, S.R.N., S.C.M. Third Edition. Revised by M. A. Gannon, S.R.N., S.C.M. 1941. Baillière, Tindall and Cox, London. Pp. xii plus 495, with 162 illustrations. Price, 8s. 6d.

THIS book gives a very comprehensive study of midwifery and maternity nursing.

It is obviously the work of an experienced and gifted teacher—it is so well written and explained that no pupil could fail to understand it readily. The knowledge is also presented in such a way that one reads with continued interest.

The numerous diagrams are also of valuable assistance to both teacher and pupil alike.

In addition the final chapters on 'Government Services', 'History of Nursing', etc., contain interesting general knowledge for all.

I. C.

**A SHORT TEXTBOOK OF SURGERY.**—By C. F. W. Illingworth, M.D., Ch.M., F.R.C.S. Ed. Third Edition. 1942. J. and A. Churchill Limited, London. Pp. x plus 692, with 12 plates and 201 text-figures. Price, 27s.

PROFESSOR ILLINGWORTH has succeeded admirably in his desire to produce a satisfactory textbook of surgery which is both short and comprehensive. This book is already well known and the present edition is the third since 1938.

The war has been responsible for rewriting of various sections on wound treatment, burns, shock, gas gangrene, and blood transfusion. Changes and amendments have been made elsewhere and a new chapter on 'Safety factors in surgery' has been added.

The arrangement and the phraseology of the work conform to the general type of surgery textbook but, unlike some others, the subject-matter is concise and cuts out all 'trimmings' including operative details.

Illustrations and x-ray photos are not profuse but are satisfactory in showing clearly what they are meant to show.

This book can be recommended to the student as being of reasonable length and sound teaching, easy to read, well bound, and well printed. It will be of use also to the practitioner to keep in touch with general surgery as a whole without attempting to be too specialized.

K. S. F.

**TRAUMA AND DISEASE.**—Edited by Leopold Brahdry, B.S., M.D., and Samuel Kahn, B.S., M.D. Second Edition. 1941. Henry Kimpton, London. Pp. 655. Illustrated. Price, 35s.

THIS interesting book is the joint effort of twenty-four authors including the editors. The subject of ætiological relationship between trauma and disease, though always recognized, has not been given the attention which its importance merits. In this volume what has been considered very carefully is the effect

of a single trauma either physiological or psychic, on the production of disease or its course. This admittedly is a difficult subject but the quick appearance of a second edition is sufficient evidence that this volume has justified its publication.

This is a book of considerable volume, consisting as it does of 655 pages and 18 chapters. This need not cause any surprise because no special branch of medicine and surgery has been neglected. This book will therefore be acceptable equally to the general practitioner and the specialist. It is no small praise for the authors. The bibliography and the index will be found very helpful. The printing and get-up are excellent.

P. N. R.

**MASSAGE AND REMEDIAL EXERCISES IN MEDICAL AND SURGICAL CONDITIONS.**—By Noel M. Tidy. Fifth Edition. 1941. John Wright and Sons Limited, Bristol. Pp. xii plus 463. Illustrated. Price, 17s. 6d.

THE fifth edition of this book needs no introduction to students and practitioners of massage and remedial exercises. It is an admirable textbook containing an account of various modern methods of treatment and indicating where further information can be obtained.

All the treatments recommended appear to have been personally tested.

The exercises described form an excellent collection, containing instructions for all conditions likely to be met in any massage department. They are well illustrated and easy to follow. Special discrimination has been made between passive movements—relaxed or forced—and active exercises.

Special attention is paid to the treatment of fractures approximate dates being given for beginning movements in the various joints.

This new edition contains a short and very useful section on the treatment of serious burns and of amputation stumps, especially as regards their preparation for the fitting of artificial limbs. There is also a short description of the modern treatment of wounds.

Since the first edition of this book came into my hands I have never been without a copy of it, and have referred to it innumerable times. Here in India, where most hospitals and medical colleges have no massage departments, and students are unable to realize the uses of massage and exercises, this book would be a valuable asset to medical students. It would help them to realize the variety of cases in which massage and exercises can be employed with advantage.

P. B.

## Abstracts from Reports

**REPORT OF THE MEDICAL OFFICER OF HEALTH, SIMLA MUNICIPALITY, FOR THE YEAR 1941. BY COLONEL E. S. PHIPSON, C.I.E., D.S.O., M.D., F.R.C.P., D.P.H., D.T.M. & H., I.M.S. (RETD.)**

The population of Simla fluctuates greatly between the summer and winter periods. The rates per mille of population are based on an 'average' population which is obtained by addition of 5/12ths of the winter and 7/12ths of the summer populations.

The average population =  $(5/12 \times 18,144) + (7/12 \times 52,187) = 38,003$ .

There were 799 live births and 16 still births. The last number represents a proportion of 3.77 of the total births as compared to 8.84 in 1940 and 4.25 in 1939.

Four hundred and eight deaths, 249 males and 159 females, were registered in 1941. The total number of deaths gives a 'crude' death rate of 10.74 per mille of the population as compared to 10.79 per mille in 1940.

Respiratory diseases caused 160 deaths which constitute 39 per cent of the total deaths. Twenty deaths resulted from 'fevers' constituting 5 per cent of the total deaths. One hundred and ninety-eight deaths were recorded under the heading of 'all other causes' representing 49 per cent of the total deaths.

The total number of births recorded during the year was 799 and the crude infant mortality was 14.65 per 100 births.

The school medical service scheme included 25 Indian schools which were inspected by the two medical officers who examined a certain number of pupils at each visit and referred dental and eye cases to the specialists.

The records of individual examinations of school children during the year under report, reveal a general standard of health which can only be described as deplorable. According to the statistics given, only 12.47 per cent of boys and as few as 1.25 per cent of girls can be described as in 'good' health, that is, without any recognizable defect. Those with one defect are described as 'below par', and these amount to 22.99 per cent of boys and 4.28 per cent of girls, and those who are described as being in 'poor health',

that is, with more than one defect, form the majority, being 64.55 per cent in boys and no less than 94.47 per cent in girls, a sex difference which suggests a relation to the greater proportion of the day which girls spend in the seclusion of their own homes, all too often unhealthy and insanitary.

There have been many important developments during the past twenty years. Perhaps the most important of all was the increase in the water supply by the installation, in 1924, of the pumping plant at Guma, capable of delivering from the waters of the Nauti Khud a maximum of 600,000 gallons a day, an increase which almost doubled the supply available twenty years ago. The electricity supply, on which the water supply is dependent to an extent which the public do not perhaps fully realize—80 per cent of the water supply being now electrically pumped—was further strengthened by the erection in 1939 of a Diesel generating plant at Idgah, with a nominal output of 800 kilowatts. To this must be added the greatly increased efficiency of the precautions for ensuring the bacteriological purity of the supply by chlorination at the head of the rising main at Carignano, for the Guma water and 'chlorination' for this and for water from all other sources at Sanjauli reservoir.

Perhaps the next most striking improvement in the field of public health is the greater regard for the convenience of the public, and particularly for the poorer sections of the community, shown by the provision of valuable amenities, such as the ladies' park, on the site of Lowrie's hotel, and shelters for rickshaw coolies, in different parts of the town. In the realm of education, of the 11 municipal schools, 4 have been built by the municipality in the last twenty years; the school medical service is of comparatively recent growth, and the introduction of the supply of free milk to under-nourished indigent children, though latterly its results have been disappointing, is evidence of progress.

One of the earliest municipal experiments in maternity and child welfare in India was started in Simla some twenty years ago and the enterprise has developed into a considerable undertaking on which the municipal committee spend Rs. 10,000 a year, and which employs a staff of three fully-trained lady health visitors.

The improvements in recent years in the municipal markets and dairies have been very substantial, and though the new vegetable market, for reasons which need not be entered into, has proved to be a white elephant, it is on the whole, well designed for its purpose.

Municipal efforts for the control of tuberculosis are also of recent date, and though the scope of the present scheme is very restricted, there was nothing in its place twenty years ago, and they represent a forward step. The extension of the scheme is now under consideration by the municipal committee.

Among other improvements are the abolition of all areas where prostitution was officially tolerated, the medical examination of rickshaw coolies before licensing; their periodical cleansing and disinfection by municipal agency; the improvements in their housing arrangements and the introduction of a standard light rickshaw; and the covering by concrete slabs of the very dangerous open nullahs in the bazaar area which have been the cause of more than one fatal accident.

The milk supply of Simla is still far from satisfactory, and little or no progress can be recorded in the last twenty years or, indeed, in the last half-century. The difficulties are obvious; the milk supply is brought almost exclusively from outside municipal limits, and Simla is an island entirely surrounded by the territories of Indian States, where the municipal committee has no jurisdiction in sanitary or any other matters.

There is one respect in which Simla would seem to have actually retrogressed in the past twenty years, and that is in housing conditions for the poorer classes, and in the state of congestion in the bazaar area. The municipal committee have recently taken up this matter, and a number of insanitary properties have been surveyed with a view to condemnation or improvement and one may hope that some progress in this direction may at last be made.

It is fortunate indeed that in the past twenty years there have been compensating improvements in the direction of water supply, electricity and drainage and that at least these very important factors in the health of the station have received in the past and are still receiving some, at least, of the attention they deserve. The year 1942 promises to impose a practical test of Simla's resources in many directions, not least in the field of public health.

#### KASHMIR MEDICAL MISSION HOSPITAL OF THE CHURCH MISSIONARY SOCIETY REPORT FOR 1941

The Kashmir Mission Hospital is one of the most important public institutions in Kashmir. The hospital is able to cope, to a greater or less extent, with the sickness and disease of the valley of Kashmir, partly because villages near the river can send in patients by water; and to others district visits are paid.

It is interesting to note the prevalent diseases as met with in district work. Of 5,000 cases, worms (ascarides) formed 29 per cent of the whole, the juvenile population being almost universally affected. Next come diseases of the alimentary system, 28 per cent, chiefly due to want of variety and excess of starch in the ordinary rice diet. Respiratory troubles, 8 per cent, were chiefly chronic bronchitis. Tuberculosis of the lungs, 0.5 per cent, is beginning to make its appearance in the villages. Rheumatism, 7 per cent, like the two preceding is doubtless owing to exposure to cold and damp and insanitary houses. Skin diseases, 4 per cent, were chiefly scabies and favus, both of a severe type and also eczema. Eye affections formed 10 per cent of the whole, and were chiefly trachoma, entropion, trichiasis, pterygium and conjunctivitis. About 1 per cent of the cases had goitre, which in some districts, with limestone springs and probable drainage contamination, is endemic. Seven per cent of the patients were suffering from disease necessitating operation.

The nature and extent of the medical and surgical work is notable. A large number of eye operations were performed and tumours removed. On kangri-burn cancer our work has been regarded as authoritative.

*Maternity and infant welfare work.*—In the Mission hospital about one-third of our patients are women and children. We have comparatively little maternity work. But what there is, is of the utmost importance and gravity. Osteomalacia is common in Kashmir. Many patients give a history of one or more living children and then labours of increasing difficulty, growing deformity, and finally they are brought into hospital with acute dystocia.

*Acknowledgments.*—Our thanks are due to His Highness the Maharajah for the continued support of his three beds and for the gift of rice on His Highness' birthday and to His Highness' Government for the State grant. To bed and cot supporters and shareholders and to all subscribers and donors to our funds, who, in spite of many calls on their charity due to the war, have nevertheless generously helped us, we tender our grateful thanks.

#### REPORT OF THE CHEMICAL EXAMINER TO GOVERNMENT, PUNJAB, FOR THE YEAR 1940

*Total work done.*—Compared with the year 1940 the total number of cases investigated in the chemical examiner's department during the year under report rose from 4,763 to 4,836 and the number of articles examined went up from 12,778 to 12,886 giving an increase of 73 under the former and 108 under the latter. The increase is under one head only, viz, 'general analysis' both for cases and articles while there is a decrease under almost all other heads.

*Percentage of detection.*—So far as the percentage of detection is concerned there is decrease under several heads, viz, from 60.38 to 55.41 under human poisoning cases, from 94.82 to 94.10 under blood stain cases and from 93.32 to 89.96 under cases relating to sexual offences. The only increase is from 37.21 to 57.14 per cent under cattle poisoning cases.

*Fatal human poisoning cases.*—Of the total number of 953 cases examined for human poisoning 582 were fatal including 9 cases of criminal abortion and poison was found in 522 cases. The percentage of detection was 48.69 as compared with 55.63 in 1940. The cause of death was other than poisoning in 275 cases as against 238 cases in the previous year. If these non-poisoning cases are excluded the percentage of detection comes to 93.62 as compared with 94.69 in 1940. The fall in percentage is due to the growing tendency among medical officers to send the viscera of all such cases to the chemical examiner to Government, Punjab, for examination even when there is little or no suspicion of poisoning. The practice is not appreciable as medical officers do not appear to exercise their discretion with proper care in such cases. Lahore as usual sent the largest number of cases, viz, 53 followed by Amritsar 38, Kasur 33, Delhi 30 and Lyallpur 22. There is not much variation as compared with the figures of the year 1940 except that Amritsar occupies second position and Jullundur comes much down on the list. Opium, arsenic, dhatura, alcohol, strychnine, mydriatic (belladonna) and cyanide were the chief poisons used.

*Fatal cattle poisoning cases.*—Of 42 cases examined under animal poisoning cases as against 43 in 1940 only 34 cases were fatal and the percentage of detection was 55.88 as compared with 35.90 in the previous year. Arsenic was the chief poison used though Abrus precatorius was also found in 5 cases. The largest number of cases was received from Rawalpindi 8, Lahore 6, and Sialkot 3.

*Stain cases.*—The total number of stain cases examined in 1941 was 1,891 consisting of 1,356 murder cases, 384 rape cases, 144 sodomy cases and 7 cases of miscellaneous nature with 4,373 exhibits as against 2,131 cases and 4,796 articles in the previous year. Out of these, 1,355 cases comprising 3,114 articles were

referred to the Imperial Serologist, Calcutta, the corresponding figures for the year 1940 being 1,596 and 3,567, respectively.

*General analysis of cases.*—The total number of articles examined for general analysis in 1941 was 3,696 consisting of 2,395 samples of beverages, 39 samples of water, 59 samples of food, 189 samples of miscellaneous articles, 838 samples of drugs and 176 explosives as against an aggregate of 3,009 articles in 1940.

*Staff.*—There were several important events among the members of the staff, viz, reversion of Lieut.-Colonel D. R. Thomas, O.B.E., I.M.S., chemical examiner, to the military duty from 13th August, 1941, grant of one year's extension in service to Dr. Syed Tufail Hussain, assistant chemical examiner, from the 16th April, 1941, re-employment of Dr. Udho Ram from the 20th August, 1941, as chemical examiner and death of Dr. Salig Ram Khanna, 1st assistant to chemical examiner, on 17th April, 1941.

# KING EDWARD VII MEMORIAL PASTEUR INSTITUTE AND MEDICAL RESEARCH INSTITUTE, SHILLONG: THE TWENTY-FOURTH ANNUAL REPORT FOR THE YEAR ENDING 31ST DECEMBER, 1940

## ANTIRABIC SECTION

In addition to the Pasteur Institute, Shillong, 25 public centres and 46 private centres, at which anti-rabic treatment was available to the public, were maintained during this year.

The total number of persons applying for treatment throughout the province amounted to 2,857. Shillong received 487 of these persons and the remainder attended the various centres. Treatment was completed in the case of 2,434 persons. This represents an increase of 544 over the corresponding figure in 1939. In addition, four persons applied for, and were placed under treatment, when they were in the late incubation stages of hydrophobia. Treatment in these cases was not completed, owing to its interruption by the onset of hydrophobia in each case, followed by inevitable death.

Of the 2,857 persons applying for treatment, 192 were treated as 'advice cases'. This means that they were either not treated at all, or their treatment was stopped before completion of the course, because circumstances showed that they were at no risk. Among the persons placed under treatment and presumed to be at risk, 225 absconded without completing the course. All efforts to induce them to finish the treatment were unavailing, and there is no record of their eventual fate.

*Results of treatment.*—There were four deaths from hydrophobia among the 2,434 persons fully treated, giving a mortality rate of rather more than 0.16 per cent. The inclusion of the four additional persons referred to above who died during treatment, brings up the mortality rate among the 'Total Treated' to 0.34 per cent. All the eight deaths occurred among Asiatic patients. One death from hydrophobia occurred among patients treated in Shillong, a *malis* who received no less than 30 severe wounds from a stray dog.

There was one case of paralytic accident during the year. He received the full 14 days' treatment and the onset of paralysis appeared one day after treatment was completed. This was an unfortunate case. Paralysis following antirabic treatment, except in the most serious ascending myelitis (Landry type), usually tends to gradual recovery, complete or incomplete after a greater or less lapse of time, in the absence of serious complications. In this case such complications unfortunately occurred and a fatal termination resulted.

## ASSAM MEDICAL RESEARCH SOCIETY

The Society continued to confine itself to the study of malaria and its control during the year.

*Finance.*—All the constituents of the Society maintained their contributions at the usual level in 1939-40.

The Assam Railways and Trading Company, Limited, were enrolled as constituents in 1940-41 and the Assam-Bengal Railway ceased their contribution with effect from 1939-40 as a measure of retrenchment.

*Special researches.*—(a) An experimental scheme of malaria control by spray killing adult mosquitoes with a mixture of 1 part of pyrocid 20 and 19 parts of kerosine was carried out in two areas in a tea garden and a rural area respectively. Weekly spraying with such a mixture reduced the malaria incidence by 60 per cent as shown by the hospital figures. In the sprayed area the parasite indices among adults and children showed a definite reduction in December at the end of the spraying season, while in the unsprayed area in close proximity they showed a distinct rise. The infant malaria parasite rate showed a reduction by 50 per cent in December in the sprayed area while it rose by 50 per cent in the unsprayed area. The cost of weekly spraying for a period of 8 months came to Re. 0-8-7 per head. There was no reduction in the larval output nor even any decided fall in the mosquito population in the sprayed area but the most noticeable change is the great fall in the rates of mosquito infection in the sprayed area. When the mixture is sprayed once a week the mosquitoes apparently live long enough to breed but not long enough to transmit infection.

(b) Special studies on infant indices were undertaken in some hyperendemic areas in Upper Assam. As a result of these studies it was found that in such areas the period of effective transmission is probably from May to December. The infants below 2 months inherit some degree of immunity from their mothers and the index in infants 2-3 months old is the best index of the quantum of seasonal infection being free from the immunity factor of the younger infants and the relapse factor of the older infants.

(c) In the course of the resurveys in Shillong and Gauipur intensive mosquito dissections were made to find the vector. In Shillong *A. maculatus* was the only vector found. Thirteen out of 793 or 1.6 per cent were found infected in 1940 and among these 9 out of 550 or 1.6 per cent were found infected in July, August and September.

*Treatment schemes.*—(a) This was continued in Doom Dooma where treatment of the disease was reinforced with anti-larval work. But treatment has been discontinued since 1941 due to its high cost and reliance placed only on anti-larval control which is giving quite satisfactory results.

(b) Two groups of villages, one under Tezpur Local Board and the other under Kamrup Local Board, were taken up for treatment during the height of the malaria season with funds provided jointly by the Government and the Local Boards concerned.

*Technical guidance in other control projects.*—This was furnished in 13 centres other than the experimental areas referred above. Periodical inspections were carried out and recommendations for intensifying the work made from time to time. The Society also furnished technical guidance in malaria control measures in progress in seven tea gardens. In all the centres the incidence of malaria was held under check due to the control measures.

## RESEARCH WORK

Captain A. C. Vardon, I.M.D., continued his work on the reversion of water vibrios and their relation to *V. cholerae*. His findings were published in a paper entitled '*Vibrio cholerae* and other Vibrios', *Indian Medical Gazette*, LXXV, 91, p. 522.

The Director, with Dr. Naresh Chandra Roy, commenced an investigation into the therapeutic effect of sulphonamide drugs on rabies virus infection and this was still in progress at the end of the year under review.

A study is also being made of the relationship between the serum agglutination and the findings by blood culture in enteric fever cases among the civil population in Assam and it is hoped to compile the results shortly.

## Correspondence

### BACILLARY DYSENTERY AND M.&B. 693 (SULPHAPYRIDINE)

SIR,—I was called to see a patient, aged 26 years, in a collapsed condition with pulse almost imperceptible and temperature 103°F. He had numerous stools, mixed with profuse blood, mucus and sloughs for three days and intense pain in the lower abdomen, especially the ileo-cæcal region. There was much prostration. Bacteriophage and other treatment were given at the onset of the disease. He was immediately put on M.&B. 693. His general condition improved considerably and the stools were greatly reduced. The intense pain which was the most distressing symptom disappeared within twelve hours. Blood and slough disappeared on the fourth day of treatment. He was completely cured on the sixth day.

A child, aged 2 years, started illness with temperature 104°F., diarrhoea, nausea and intense tenesmus. The stools contained blood and slough. He was given a course of bacteriophage and then anti-dysenteric serum 2 c.cm. but without any effect. I then saw him and stopped all treatment and put him on M.&B. 693. The child had 6 to 7 tablets in all. The result was dramatic within 18 hours. Pain had gone and the child slept all day long. He had healthy stool on the fifth day of M.&B. 693 treatment.

I have treated about 25 cases of bacillary dysentery of severe type by M.&B. 693 and out of 25 cases, 24 recovered successfully and one died being complicated with malaria. It appears to me as a specific for bacillary dysentery. Its special action is the relief of pain within 8 to 12 hours. Blood disappears first and the stool becomes normal within 3 to 6 days. It is relatively cheaper than serum or any other form of treatment. The earlier the treatment is started, the better is the result. I have also used M.&B. 693 in many amœbic infections with good result. The result is far superior to emetine and other drugs such as carbarsone, yatren, enterovioform and kurechi alkaloids.

S. M. ROY, L.M.P.

THE BARODA PHARMACY,  
P. O. PUKURPAR (PABNA),  
27th April, 1942.

## Service Notes

### APPOINTMENTS AND TRANSFERS

MAJOR A. N. CHOPRA, Additional Assistant Director-General, Indian Medical Service, is appointed to officiate as Additional Deputy Director-General, Indian Medical Service (Retd.), *vice* Lieutenant-Colonel S. L. Bhatia, M.C., granted leave.

Major C. A. Bozman, Port Health Officer, Bombay, is appointed to officiate as Additional Assistant Director-General, Indian Medical Service, *vice* Major A. N. Chopra.

Major W. S. Morgan, an Agency Surgeon, is appointed to officiate as Chief Medical Officer in Central India and Residency Surgeon, Indore, with effect from the forenoon of the 20th April, 1942.

Major M. Sendak, Senior Medical Officer, Port Blair, is appointed to officiate as Port Health Officer, Bombay, with effect from the afternoon of the 20th April, 1942, until further orders.

Major B. N. Khan is appointed Deputy Assistant Director-General (Medical Stores), Medical Store Depot, Raipur, with effect from 29th April, 1942.

Major B. A. Porrit is appointed Deputy Assistant Director-General (Medical Stores), Medical Store Depot, Madras, with effect from the afternoon of the 25th April, 1942, *vice* Major B. N. Khan, appointed as Deputy Assistant Director-General (Medical Stores), Raipur.

### INDIAN LAND FORCES

#### Permanent Commission

#### To be Captain (on probation)

V. R. Damle. Dated 29th March, 1942, with seniority in his present rank from 29th March, 1937, and in the rank of Lieutenant from 29th March, 1936.

#### (Emergency Commissions)

The undermentioned appointments are made :—

#### To be Lieutenants

John Brooke David. Dated 29th November, 1941, with seniority from 29th November, 1940.

Robert Munn Gilchrist. Dated 10th January, 1942, with seniority from 10th January, 1936.

Elliot Digby Macworth. Dated 10th January, 1942, with seniority from 9th April, 1936.

James Thomas Miller. Dated 10th January, 1942, with seniority from 8th March, 1941.

Neville Winter Gill. Dated 10th January, 1942, with seniority from 22nd April, 1941.

Peter Hampton Blackiston. Dated 10th January, 1942, with seniority from 4th May, 1941.

John Mockler. Dated 4th February, 1942, with seniority from 27th August, 1940.

### INDIAN LAND FORCES

#### (Emergency Commissions)

#### To be Lieutenants (on probation)

27th February, 1941

Mohammad Ayub Khan.

Raghibir Singh Rao.

Perampally Sistarama Rau. Dated 4th November, 1941.

Osmond Frederick Paise, with seniority from 5th August, 1941. Dated 21st November, 1941.

5th December, 1941

Thomas Lazaro, with seniority from 5th August, 1941.

Kuruganti Narayana Sastri.

Ranjit Singh Garewal.

Mohammad Sher Rana.

Mohan Prakash Goel.

Faiz-ullah Khan.

Balram Singh Baswani.

Vadavatt Kumar Gangadhara Menon.

Sushil Kumar Bardhan Ray.

Mohammad Shoaib Mallick.

Mihir Kumar Bose.

Atmaram Parasharam Diwan.

Arulappan Paul Devadoss.

Santosh Chandra Maitra.

Malayil Coshy Mathew.

Maddimsetti Venkataswami Naidu.

Venkatesh Vasudeo Ainapure.

Padiath Mohamed Ali.

Sankari Prasad Sinha Roy.

Man Mohan Singh.

Valaparambil Karappan Kumaran.

Damodaram Hari Rajan.

Karamcheti Suryanarayana.

Kartar Singh Grewal.

Vaidhyanthapuram Subramaniaier Gopalakrishnan.

Nalin Behari Chaudhury.

Himansu Sekhor Sinha.

Gnanabaranam David Pillai.

Venkiteswara Krishna Prabhu.

Satyendra Ramachandra Turkhud.

Krishna Rao Rajagopal.

Kurupath Balakrishnan Nair.

Varkey Kuruvilla.  
Jagjit Singh.  
Kakumanu Vullaki.  
Abul Walid Fazlur Rahman.  
Labhshanker Revashanker Mankodi.

6th December, 1941

Henry Thomas Ince, with seniority from 5th August, 1941.

Baldrade Arnold Irvine, with seniority from 5th August, 1941.

Paresh Chandra Ghosh.  
Simhadri Govinda Audinarayana Raju.  
Nitya Pada Kundu.  
Phani Bhushan Chakerberty.  
Raghunath Balkrishna Tulpule.  
Kadayam Sreenivasa Iyer Sankaran.  
P. Vadivale.

Gundu Gurty Sanyasi Rao.

Jagdeo Bahadur Singh.

Rathindra Nath Mitra.

Mandalika Rama Subba Rao. Dated 7th December, 1941.

Ganga Prasad Srivastava. Dated 10th December, 1941.

Hem Chandra Bhattacharyya. Dated 15th December, 1941.

5th January, 1942

Arcot Chandramowli Sastri.

Joseph Eapen.

Giri Sree Ramulu.

Shyam Nath Chak.

Uma Prasanna Mukherjee.

Ram Krishna Mendireth.

Abdul Bashir.

Korattiswaroopam Kochukuttan Thampuran.

N. S. Sankara Narayanan.

Vadakkedath Krishnankutty Menon.

Surath Madhava Rao.

Bhasker Rao Karnad.

N. Shri Dhara Rao.

Basheshar Nath Bali.

Rudrabhalla Kodandaram.

Ramavaram Sreenivasam Kesavaraj.

Dina Nath Maniktala.

Vasant Ramrao Sanzgiri.

Bhadrappa Devadas.

Madhay Ramchandra Dhamdhare.

Leslie McArthur Hogg.

Damodar Bhatt.

Thomas Lacey Whitty McCullagh.

Daljit Singh Goel.

6th January, 1942

Mani Mohan Chakraverti.

Bhattiprolu Sundararamamurti.

Obadiah David.

Venkataraman Hari Haran.

Kalpathi Venkateswara Ganapathi.

Francis Freitas.

10th January, 1942

Calambakkam Muthukrishnan.

Mangat Varughese Kurian.

Sebastian Zacharias.

Victor Gnanadikham.

Edgar Stanley Linton.

Venkataramana Venkatasubramanian.

12th January, 1942

Ratilal Chimanlal Swaminarayan.

P. P. Paulose.

A. H. Vatsyayana.

Thelapurath Narayana Srikumara Kurup. Dated 20th January, 1942.

5th February, 1942

Frederick Mervin Faulkland Forrest.

Hemendra Kumar Basu.

Sultan Ahmad Khan.

Naba Kumar Mukherjee.

Sachindra Nath Basu.

Sachi Kanta Sen.

Sanat Kumar Ghosh.

Sumil Kumar Ray.

Anil Chandra Ghosh.

Ezekiel Abraham Shellim.

Sailendra Nath Choudhury Bona.

Dhirendra Nath Bhattacharya.

Dines Chandra Chaudhuri.

Tara Singh Grewal.

Anil Kumar Chatterjee.

Mohammad Yusif Ghaznavi.

Kumudranjan Pramanik.

Adya Nath Ray.

Satya Pal Mehta.

Nirbhaya Thakar.

Kundan Lal.

Jalal-ud-Din.

Santosh Kumar Mukherjee.

Harbans Lal Chhabra.

Ravanasamudram Viswanathier Padmanabhan.

Jagdish Singh Sarkaria. Dated 6th February, 1942.

Najmus-Saqub Khan. Dated 7th February, 1942.

Puranganal Abraham Mathew. Dated 2nd May, 1942, with seniority from 2nd May, 1941.

The undermentioned Lieutenants (on probation) are confirmed in their rank, with effect from the dates specified :—

S. C. Ghosh. Dated 1st July, 1940.

A. Waheed. Dated 15th July, 1940.

5th August, 1941

E. B. Woodhouse.

M. W. J. J. Pinto.

E. M. Craggs.

L. A. B. Matthews.

N. J. C. deLemos.

J. F. Mason.

L. T. Lushington.

G. E. J. Burby.

P. J. Engineer.

P. O. Ittooppunny.

T. D. Narang.

S. L. Kalra.

B. Sing.

V. P. Rao.

A. A. Rawat.

I. C. Sen.

L. K. A. Anantanarayanan.

A. F. Hussain.

Rai Sahib L. P. Misra.

N. G. Chitnis.

T. P. Durairaj.

C. B. Bhargav.

V. B. Bhargav.

I. Khan.

T. R. S. Row.

F. C. Mukherjee.

J. H. Chibber.

C. L. C. Bhajekar.

6th August, 1941

D. H. Dracup.

D. N. Mehta.

G. S. Sidhu.

B. K. Bhattacharyya.

G. S. Singh.

M. N. Ghosh.

M. Talukdar.

5th September, 1941

L. A. Venkataraman.

B. S. Sachdev.

A. Hussain.

V. S. Mahadevan.

J. C. Ghosh.

T. S. Viswanathan.

J. J. Eapen.

A. Kadeer.

M. L. Madan.

P. Thanaratnan.

C. S. Mehdiratta.

T. C. Bose.

P. K. Menon.

D. R. Mendiratta.

S. K. Rana.

Nuruddin.

J. Singh.

J. A. Sonde.

S. S. Godbole.

K. N. P. S. Pillai.

D. J. Reddy.

M. A. Khan.

V. B. Kale.

A. Raghavan.

G. H. S. David.

P. Raghunadharaju.

M. P. Varma.

N. Venkataraman.

N. Krishnaswami.

6th September, 1941

P. K. Ray.

A. K. Daw.

C. S. Ramchandra.

B. K. Nandy.

B. K. Bose.

S. G. M. Shah.

M. K. Akhtar.

C. K. Hasan.

S. S. Kirtane.

S. M. Apte.

LEAVE

Lieutenant-Colonel M. A. Nicholson, C.I.E., an Agency Surgeon, Chief Medical Officer in Central India and Residency Surgeon, Indore, is granted leave from the 20th April to the 9th July, 1942 (both dates



inclusive), with effect from the afternoon of the 18th April, 1942.

#### PROMOTIONS

##### *Majors to be Lieutenant-Colonels*

M. Taylor, O.B.E. Dated 18th April, 1942.  
W. Lawie. Dated 28th April, 1942.  
F. R. W. K. Allen. Dated 5th April, 1942.

##### *Captains to be Majors*

C. F. Garfit. Dated 1st February, 1942.  
F. W. Whiteman. Dated 18th April, 1942.  
W. Mackie. Dated 20th April, 1942.

24th April, 1942

S. Ahmad.  
T. F. O'Donnell.  
H. B. Wright. Dated 7th May, 1942.

#### INDIAN LAND FORCES

##### *(Emergency Commissions)*

##### *Lieutenants to be Captains*

S. C. Ghosh. Dated 1st July, 1941.  
A. Waheed. Dated 15th July, 1941.

12th April, 1942

|                 |                     |
|-----------------|---------------------|
| J. Pereira.     | G. L. Dutt.         |
| R. K. Garde.    | K. K. Rao.          |
| S. L. Agarwala. | B. D. P. Rao.       |
| C. M. Desai.    | R. Narasinha.       |
| G. S. Ahmad.    | D. S. Krishnamurti. |
| K. P. Mukherji. | T. M. B. Nedungadi. |
| T. George.      | W. S. Raju.         |
| C. I. Somaya.   | V. Raghavachar.     |
| P. S. Bhargava. | A. N. Banerji.      |
| S. M. Dutt.     | T. U. Poonen.       |
| G. Ray.         | B. N. Singh.        |
| F. M. Khan.     | A. R. Deshpande.    |
| V. B. Menon.    | S. P. Bhalla.       |
| S. A. Sheikh.   | A. K. Thomas.       |

A. N. Subbaraman. Dated 13th April, 1942.

## Notes

### BOVRIL LIMITED

#### EVEN DISTRIBUTION OF SUPPLIES

##### *Lord Luke's review*

PRESIDING at the forty-fifth annual general meeting of Bovril Ltd., held in London on 26th March, 1942, the Lord Luke, K.B.E. (chairman), said that since the issue of their report they had suffered a sad loss in the death of their vice-chairman, the Duke of Atholl. He had had a very distinguished career. He had been a brave soldier, an active member when in the House of Commons, and a great chieftain in his own country. He had joined their Board fifteen years ago and had been a helpful director, having been popular with the Bovril staff and employees both here and abroad.

##### *Elasticity of organization*

The Bovril organization, which had been built up during all these years, could show considerable elasticity at a period like this, not only in the production of Bovril but particularly of emergency rations and other food products, and by intensive work by day and night, etc., the output of all these was at least three times what it was in 1939.

During the period under review considerable trouble had been taken to distribute the supplies of Bovril as evenly as possible.

##### *Nation's general nourishment never better*

As chairman of the Ministry of Health's Committee on Nutrition, he had listened to some of the best informed dietitians, health experts, and statisticians discussing the question of the nation's diet.

There had been general agreement on the main facts, but he was sure progress would have been painfully slow if we had not come to a period of rationing. The last two years have given an opportunity that had so wisely been taken advantage of, and he should not be surprised if the nation was better nourished than ever before.

##### *Monotonous meals*

One, of course, heard talk of the monotony of our meals simply because we missed that infinite variety of tasty extras that used mostly to come from overseas in ships with great refrigerators. Obviously we had to forget such dainties for the present, though after the war they should begin to come again. However, we must hope that the improvements in the main features of the nation's nutrition would not be discarded and cast aside lightly.

##### *No increase in the price of Bovril*

They were rather proud of the fact that since Bovril was first marketed, over half a century ago, its price had never been raised during a period of war. There was no increase during the 1914-18 war, nor had the price been raised during this war, in spite of the general increase in prices all round. He hoped that they would be able to maintain this record, as he was anxious that they should do so in order to avoid penalizing the many thousands of regular consumers of Bovril who relied on it especially during trying times.

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## Original Articles

### ENTERIC FEVER IN CALCUTTA

By L. EVERARD NAPIER, C.I.E., F.R.C.P. (Lond.)  
R. N. CHAUDHURI, M.B. (Cal.), M.R.C.P. (Edin.),  
T.D.D. (Wales)

and

M. N. RAI CHAUDHURI, M.B. (Cal.)  
(From the School of Tropical Medicine, Calcutta)

*Introduction.*—In western countries the present-day attitude towards the enteric fevers in India is reflected by Manson-Bahr in the 1940 edition of his invaluable book. He considers it to be the scourge of recently arrived young Europeans in India, 'but, fortunately, liability to infection decreases with length of residence, due apparently to a kind of acclimatization. The well-known immunity of native races to typhoid is probably due either to mild attacks of the disease in childhood or to the immunizing effect of living in constant contact with typhoid infection. The typhoid and paratyphoid infections among Europeans in the tropics appear to be more virulent, and to cause a death rate twice as heavy as that commonly observed in England. According to English statistics, the death rate is given as about 1:8 attacked, but in India only recently the death rate is stated as rather over 1:3'.

'Enteric fever' is a comprehensive term designating fevers due to infection with *Bacterium typhosum* (*Erberthella typhi*), as well as with some of the *Salmonella* group of organisms. The word 'typhoid', though often used synonymously with enteric fever, should be applied strictly to the former infection. Distinction is seldom made between typhoid, paratyphoid, and possibly allied infections in the statistics of enteric fever.

Although a typical case of typhoid fever can usually be recognized clinically, certainly after the first week, the diagnosis, either positive or negative, based only on signs and symptoms is not always reliable; autopsies performed on fatal cases of so-called typhoid fever diagnosed clinically have on many occasions revealed an altogether different condition. Conversely, many typhoid cases, especially the atypical ones, are passed as unexplained pyrexia, escaping recognition for want of proper bacteriological investigation. On the other hand, it is not uncommon to come across cases that appear to be typhoid clinically, but in which the diagnosis cannot be bacteriologically confirmed even after repeated examinations, while no other cause can be found. It is probable that some of these cases are instances of infection due to allied enteric organisms, such as *Bact.*

*metalkaligenes* and *Alkaligenes faecalis*. We have observed that these cases are liable to develop a more serious course than the bacteriologically diagnosed cases of typhoid, and the patient often dies. Published figures of typhoid mortality from different provinces include all typhoid-like fevers, and therefore do not represent bacteriologically diagnosed typhoid infection.

A better appreciation of the clinical course, and prognosis in this group of fevers will not be obtained until a larger percentage of cases are diagnosed bacteriologically, and not simply clinically, or by the Widal reaction which is susceptible to misinterpretation. The Army authorities recognized this fact even in the last war, and though the cynically minded will point out that, by refusing to recognize anything but a bacteriological diagnosis, they have devised a means of reducing the incidence of enteric to about a tenth of its previous proportions, their action certainly clarified the position and excluded many cases of undiagnosed fever that were not enteric in origin.

In order to ascertain how far our own experience tallies with the foreign and the local conceptions of enteric fever in India, we undertook an analysis of enteric cases treated by us during the last four years.

#### *The patients*

The subjects of this analysis are 77 patients admitted to the hospital attached to the Calcutta School of Tropical Medicine during the last four years, in which a diagnosis, either clinical or bacteriological, of enteric fever was made. The Widal control cases were patients in the same hospital. All the patients were from a class in which anti-typhoid inoculation is rare. Except in one case there is no evidence that any patient was inoculated.

The causative organism was isolated in 38 cases and in 39 the diagnosis was dependent on other observations, usually on the Widal reaction.

#### *Epidemiology*

*Seasonal prevalence.*—The monthly incidence of the cases, according to the date of admission, is given below; the largest number of patients were admitted in July. Cases however occur at all times of the year.

| Cases    |      | Cases     |       |
|----------|------|-----------|-------|
| January  | .. 6 | July      | .. 12 |
| February | .. 6 | August    | .. 5  |
| March    | .. 6 | September | .. 7  |
| April    | .. 3 | October   | .. 8  |
| May      | .. 8 | November  | .. 4  |
| June     | .. 6 | December  | .. 6  |

*Race.*—The series included 33 Bengalis, 20 Europeans and Anglo-Indians, 21 Indians from other provinces, 1 Persian and 2 Jews. The

distribution according to bacteriologically positive and negative groups was as follows :—

|                     | Positive group cases | Negative group cases |
|---------------------|----------------------|----------------------|
| Bengalis ..         | 15                   | 18                   |
| Anglo-Indians ..    | 7                    | 7                    |
| Europeans ..        | 2                    | 4                    |
| Punjabis ..         | 5                    | 3                    |
| United Provinces .. | 3                    | 3                    |
| Beharis ..          | 1                    | 2                    |
| Madrasis ..         | 3                    | 0                    |
| Jews ..             | 2                    | 0                    |
| Assamese ..         | 0                    | 1                    |
| Persian ..          | 0                    | 1                    |

*Occupation.*—The following table gives the occupation in 31 cases; the rest were women or children or gave no information regarding their occupations.

|                          | Bacteriologically positive | Bacteriologically negative | All |
|--------------------------|----------------------------|----------------------------|-----|
| Students ..              | 6                          | 4                          | 10  |
| Office workers ..        | 2                          | 6                          | 8   |
| Professional ..          | ..                         | ..                         | 3   |
| Medical ..               | 1                          | 1                          | ..  |
| Legal ..                 | ..                         | 1                          | ..  |
| Engineers ..             | 1                          | 1                          | 2   |
| Excise officer ..        | ..                         | 1                          | 1   |
| Manual workers ..        | 1                          | 3                          | 4   |
| Laboratory assistants .. | 1                          | 1                          | 2   |
| Sweeper ..               | ..                         | 1                          | 1   |
| TOTAL ..                 | 12                         | 19                         | 31  |

*Age.*—The youngest patient in this series was 2½ years and the oldest 51 years. Twelve were under 12 years of age. In the bacteriologically positive group, the incidence varied from 2½ to 41 years. There were ten cases in the positive series and 11 cases in the negative series, between 11 and 20 years. About 90 per cent patients of the positive series and 77 per cent of the negative ones were aged 30 years or under.

*Sex.*—There were 51 males and 26 females in this series, but no conclusion can be drawn from this, as beds in the female wards of the hospital are more limited. The ratio of male to female beds is about 3 : 1, so that, if anything, the figure suggests a relative female preponderance. In the positive group there were 26 males and 12 females, while the negative series included 25 males and 14 females.

The distribution curve (age and sex) is given below :—

| Age in years     | Under 10 | 10 to 20 | 21 to 30 | 31 to 40 | 41 to 50 | 51 to 60 |
|------------------|----------|----------|----------|----------|----------|----------|
| Bact. +ve series |          |          |          |          |          |          |
| Male ..          | 8        | 7        | 9        | 1        | 0        | 0        |
| Female ..        | 4        | 5        | 2        | 0        | 1        | 0        |
| Bact. -ve series |          |          |          |          |          |          |
| Male ..          | 3        | 7        | 9        | 5        | 0        | 1        |
| Female ..        | 4        | 8        | 0        | 2        | 1        | 0        |
| TOTAL ..         | 19       | 27       | 20       | 8        | 2        | 1 = 77   |

*Family history.*—Only two patients gave a history of recent typhoid infection in their families; both were in the bacteriologically positive group.

*Past history.*—Five patients, three in the bacteriologically positive group, gave a history of previous attack of enteric and only one a history of inoculation.

### Clinical features

*Onset.*—There was a gradual onset in the majority of the cases that were admitted early. There was a definite chilliness at the onset in 11 cases of which four were bacteriologically positive, pains all over the body in two cases, nausea and vomiting in two, sweating in two, and headache in 12 cases of which five were bacteriologically positive.

*Temperature.*—This took one of the forms shown in the tabular statement below. The figures indicate the number of cases in each group.

|  | Bacteriologically positive | Bacteriologically negative |
|--|----------------------------|----------------------------|
| High continued (above 103°F.)          | 5                          | 6                          |
| High remittent (above 103°F.)          | 16                         | 8                          |
| Moderate remittent (101°F. to 103°F.). | 10                         | 14                         |
| Moderate continued ..                  | 4                          | 4                          |
| Intermittent ..                        | 3                          | 7                          |
|  | 38                         | 39                         |

### Special clinical features

*Exanthema.*—One Indian patient developed rose spots on the chest on the ninth day of illness.

*Bradycardia.*—The pulse rate was definitely slow (100 or under with a temperature of 102° or over) in eight cases (10.4 per cent) only, of which two were bacteriologically positive; thus a slow pulse was relatively uncommon in this series of cases.

*Tongue.*—This was usually coated; the observations on this point on admission are shown below :—

|               | Bact. +ve cases | Bact. -ve cases | All |
|---------------|-----------------|-----------------|-----|
| Coated ..     | 28              | 28              | 56  |
| Clean ..      | 2               | 5               | 7   |
| Stomatitis .. | ..              | 1               | 1   |
|               |                 |                 | 64  |

*Spleen.*—This was palpable in 22 cases, 12 of which were bacteriologically positive.

*Liver.*—This was palpable in 18 cases, ten of which were bacteriologically positive.

*Bowels.*—In 23 cases no abnormality of the bowels was noted; in 41 there was constipation, and in 13 diarrhoea, of which four had a dysenteric condition.

*Complications.*—The complications noted were as follows :—

|                                   |    |                                 |    |
|-----------------------------------|----|---------------------------------|----|
| Acute oedema of the lung ..       | 1  | Tympanitis ..                   | 10 |
| Broncho-pneumonia ..              | 4  | Abdominal rigidity ..           | 1  |
| Bronchitis ..                     | 20 | Tender gall-bladder ..          | 1  |
| Toxic symptoms, delirium, etc. .. | 4  | Bed sores ..                    | 1  |
|                                   |    | Phlebitis ..                    | 1  |
|                                   |    | Slight hæmorrhage from bowel .. | 1  |

*Intercurrent infections.*—Each of the following conditions was noted once as an intercurrent infection :—tuberculosis, cholera, kala-azar, and ascaris infection.

#### The blood picture

A blood count was done soon after admission in 48 cases; some of the features are given below :—

*Hæmoglobin.*—This was done with the Hellige hæmoglobinometer, the results were recorded in grammes of hæmoglobin per 100 c.cm. of blood. It varied from 5.9 (43 per cent) to 16.5 (120 per cent) grammes. The frequency distribution is given below :—

| Grammes of hæmoglobin per 100 c.cm. of blood | Cases |
|--|-------|
| Under 9 .. ..                                | 3     |
| 9 to 11 .. ..                                | 12    |
| 11.1 to 13.75 .. ..                          | 22    |
| Above 13.75 .. ..                            | 8     |

*Red cells.*—The red cell count varied from 2.20 to 5.76 millions per c.mm. as shown below :—

| Red cell count in million per c.mm. | Cases | Leucocyte count in thousands per c.mm. | Cases |
|-------------------------------------|-------|--|-------|
| Under 3 ..                          | 1     | Under 5 ..                             | 13    |
| 3 to 4 ..                           | 11    | 5 to 7 ..                              | 13    |
| Above 4 ..                          | 35    | 7.1 to 10 ..                           | 13    |
|                                     |       | Above 10 ..                            | 9     |

*Leucocytes.*—The total leucocyte count varied from 1,500 to 15,400 per c.mm. The frequency distribution is given in the table above.

*Comment.*—There is thus nothing very characteristic in the blood picture and little diagnostic assistance, except of a negative nature, can be expected from it. There is slight anæmia in the majority of cases, but the average white cell count is probably above the normal in this country, where a count of under 5,000 is not uncommon in apparent health.

#### Diagnosis

*Bacteriological.*—A blood culture\* was taken on admission, or immediately typhoid was suspected, and blood for Widal at the same time and every five days subsequently. Stools were examined daily for five days.

|                                    | Cases |
|------------------------------------|-------|
| (a) Blood only .. ..               | 18    |
| (b) Stools only .. ..              | 8     |
| (c) Urine only .. ..               | 1     |
| (d) Blood and stools .. ..         | 6     |
| (e) Blood, stool and urine .. ..   | 2     |
| (f) Marrow, blood and stools .. .. | 3     |
|                                    | 38    |

Sternal puncture was done in eight cases, in five of the positive series of which three gave a positive culture, and in three of the negative series. In no case was the sternal puncture alone positive.

In 38 cases organisms of the enteric group were isolated; in 33 *Bacterium typhosum* was isolated and in five *Bact. paratyphosum A*.

In 29 cases it was isolated from the peripheral blood; these included three paratyphoid cases.

The duration of the disease at the time the blood was taken is shown in the table below :—

#### Time of first positive culture

|          | Blood | Stools |
|----------|-------|--------|
| 1st week | 9     | 3      |
| 2nd "    | 11    | 10     |
| 3rd "    | 3     | 3      |
| 4th "    | 3     | 1      |
| Later .. | 5     | 2      |

In two cases of the last group (blood), there was a clinical relapse.

In two instances a second culture was positive in the 4th and 5th weeks, respectively, but in these cases there was also a clinical relapse.

Enteric group organisms were isolated from the stools in 19 cases, of which two were paratyphoid A.

The duration of the disease in these cases when the organisms were first isolated is shown in the table above.

In four cases, a second positive culture was obtained during the 2nd, 3rd, 4th and 5th weeks, respectively.

*Bact. typhosum* was isolated from the urine in three cases after the 4th week.

In all except one case the clinical picture was in keeping with the bacteriological diagnosis. In this case, the clinical course was irregular and it seems possible that he was a

\* The syringe is oil-sterilized and skin cleansed with iodine, washed off with spirit; the blood (5 c.cm.) is put directly into a bottle of nutrient digest broth provided by the bacteriological laboratory.

temporary carrier; the O-agglutination was positive in a dilution of 1 in 100 to *B. paratyphosum A*, only once of seven tests.

### Serological diagnosis

The diagnosis was made on the clinical picture supported by the results of the Widal\* reaction, in 39 cases.

TABLE I

|                  | Number of cases |    | Percentage of cases negative or positive in each dilution |    |
|------------------|-----------------|----|---|----|
|                  | H               | O  | H   | O  |
| All negative ..  | 39              | 21 | 64  | 34 |
| Positive 1 in 25 | 6               | 2  | 36  | 66 |
| 1 in 50          | 7               | 11 | 26  | 62 |
| 1 in 100         | 5               | 13 | 15  | 44 |
| 1 in 200         | 4               | 9  | 7   | 23 |
| 1 in 400         | 0               | 2  | 0   | 8  |
| 1 in 800         | 0               | 3  | 0   | 6  |

\*The Widal reaction was done in the bacteriological department of the School under the charge of Lieut.-Colonel C. L. Pasricha, I.M.S., and later of Dr. G. Panja.

Dr. K. P. Banerjee was personally responsible for most of the tests and we have to thank him for the data regarding the control cases which he very kindly extracted from the ward and laboratory notes.

The Dreyer technique was used; the antigens were prepared by the standard method and the titre standardized against high-titre sera received from Oxford.

*Controls.*—This opportunity was taken of analysing the results of the H- and O-agglutination readings in the Widal of 61 patients in the hospital during the same period, (1939-40) in which a diagnosis other than enteric was eventually made. The results are shown in tabular form (table I) classified according to highest dilution in which a positive reading was obtained. The highest agglutinations were with typhoid antigen in each case. In 12 cases more than one test was carried out; the highest reading only is considered.

*Enteric cases.*—Tables II and III show the results of the agglutination tests with O and H antigens, respectively, with the enteric group organism which was demonstrated, or which was assumed to be the causative organism, as the case may be, according to (a) the highest positive dilution in which agglutination occurred, (b) the week of the disease, and (c) whether a bacteriological diagnosis was made. In tables II-a and III-a these data are summarized and the numbers and percentages of cases in which a positive Widal reaction at 1 in 100, 1 in 200, and 1 in 400 dilutions, respectively, at different weeks of the disease was obtained are shown. In these tables the agglutination referred to is against the specific antigen, *Bact. typhosum* or *Bact. paratyphosum A*, as the case may be.

The agglutinations were much higher with the former antigen, and in fact in the five cases of paratyphoid the agglutination was :—(i) negative up to the 17th day; (ii) negative up to

TABLE II : O-agglutination

| Dilution                 |          | 1 in 1,600 or over | 1 in 800 | 1 in 400 | 1 in 200 | 1 in 100 | 1 in 50 | 1 in 25 | Negative | Number tested |
|--------------------------|----------|--------------------|----------|----------|----------|----------|---------|---------|----------|---------------|
| Duration                 | Bact.    |                    |          |          |          |          |         |         |          |               |
| 1 to 7 days ..           | { +ve .. | ..                 | ..       | 1        | 6        | 1        | ..      | 2       | 1        | 10            |
|                          | { -ve .. | ..                 | ..       | 1        | 1        | ..       | ..      | ..      | 3        | 5             |
| 8 to 14 days ..          | { +ve .. | ..                 | 3        | 2        | 16       | 4        | 1       | 1       | 2        | 29            |
|                          | { -ve .. | ..                 | 1        | 3        | 6        | 5        | 2       | ..      | 10       | 27            |
| 15 to 21 days ..         | { +ve .. | 2                  | 3        | 10       | 11       | 1        | 1       | ..      | 3        | 31            |
|                          | { -ve .. | 3                  | 1        | 2        | 15       | 5        | 1       | ..      | 5        | 32            |
| 22 to 28 days ..         | { +ve .. | 5                  | 6        | 9        | 7        | 1        | ..      | ..      | 2        | 30            |
|                          | { -ve .. | 3                  | 4        | 8        | 7        | 4        | 3       | 1       | 3        | 31            |
| Later : maximum reading. | { +ve .. | 14                 | 6        | 8        | 4        | 2        | 1       | ..      | 1        | 36            |
|                          | { -ve .. | 7                  | 3        | 8        | 4        | 1        | 2       | 1       | 2        | 28            |

TABLE II-a

| Positive Widal reactions— |          |       | 1 in 100 |          | 1 in 200 |          | 1 in 400 |          |
|---------------------------|----------|-------|----------|----------|----------|----------|----------|----------|
| Duration                  | Bact.    | Total | Number   | Per cent | Number   | Per cent | Number   | Per cent |
| 1st week ..               | { +ve .. | 10    | 7        | 70.0     | 6        | 60.0     | 0        | 0.0      |
|                           | { -ve .. | 5     | 2        | 40.0     | 2        | 40.0     | 1        | 20.0     |
| 2nd week ..               | { +ve .. | 29    | 25       | 86.2     | 21       | 72.4     | 5        | 17.2     |
|                           | { -ve .. | 27    | 15       | 55.6     | 10       | 37.0     | 4        | 14.4     |
| 3rd week ..               | { +ve .. | 31    | 27       | 87.0     | 26       | 84.0     | 15       | 48.4     |
|                           | { -ve .. | 32    | 26       | 81.2     | 21       | 65.6     | 6        | 18.7     |
| 4th week ..               | { +ve .. | 30    | 28       | 93.3     | 27       | 90.0     | 20       | 66.7     |
|                           | { -ve .. | 31    | 24       | 77.4     | 20       | 64.5     | 13       | 42.0     |
| Later ..                  | { +ve .. | 36    | 34       | 94.4     | 32       | 88.9     | 28       | 77.8     |
|                           | { -ve .. | 28    | 23       | 2.1      | 22       | 78.5     | 18       | 64.2     |
| Control ..                | ..       | 61    | 27       | 44.0     | 14       | 23.0     | 5        | 8.0      |

TABLE III : H-agglutination

| Dilution                    |       | 1 in 1,600<br>or over | 1 in 800 | 1 in 400 | 1 in 200 | 1 in 100 | 1 in 50 | 1 in 25 | Negative | Number<br>tested |
|-----------------------------|-------|-----------------------|----------|----------|----------|----------|---------|---------|----------|------------------|
| Duration                    | Bact. |                       |          |          |          |          |         |         |          |                  |
| 1 to 7 days                 | +ve   | ..                    | ..       | 1        | 1        | 1        | ..      | 4       | 3        | 10               |
|                             | -ve   | ..                    | ..       | ..       | 2        | ..       | ..      | ..      | 3        | 5                |
| 8 to 14 days                | +ve   | 1                     | 1        | 2        | 10       | 3        | 1       | 2       | 9        | 29               |
|                             | -ve   | ..                    | 1        | 1        | 3        | 2        | 3       | 1       | 16       | 27               |
| 15 to 21 days               | +ve   | 1                     | 5        | 4        | 5        | 7        | 1       | 1       | 7        | 31               |
|                             | -ve   | 1                     | 2        | 2        | 10       | 2        | 4       | 1       | 10       | 32               |
| 22 to 28 days               | +ve   | 3                     | 5        | 6        | 2        | 5        | 2       | 2       | 4        | 29               |
|                             | -ve   | 3                     | 4        | 1        | 4        | 5        | 1       | 1       | 12       | 31               |
| Later : maximum<br>reading. | +ve   | 8                     | 3        | 8        | 3        | 5        | 4       | ..      | 4        | 35               |
|                             | -ve   | 6                     | 4        | 2        | 3        | 1        | 2       | 1       | 9        | 28               |

TABLE III-a

| Positive Widal reactions— |       |       | 1 in 100 |          | 1 in 200 |          | 1 in 400 |          |
|---------------------------|-------|-------|----------|----------|----------|----------|----------|----------|
| Duration                  | Bact. | Total | Number   | Per cent | Number   | Per cent | Number   | Per cent |
| 1st week                  | +ve   | 10    | 3        | 30.0     | 2        | 20.0     | 1        | 10.0     |
|                           | -ve   | 5     | 2        | 40.0     | 2        | 40.0     | 0        | 0.0      |
| 2nd week                  | +ve   | 29    | 17       | 58.6     | 14       | 48.2     | 4        | 13.7     |
|                           | -ve   | 27    | 7        | 26.0     | 5        | 5.0      | 2        | 7.4      |
| 3rd week                  | +ve   | 31    | 22       | 71.0     | 15       | 48.4     | 10       | 32.2     |
|                           | -ve   | 32    | 17       | 53.1     | 15       | 46.8     | 5        | 15.6     |
| 4th week                  | +ve   | 29    | 21       | 72.4     | 16       | 55.2     | 14       | 48.2     |
|                           | -ve   | 31    | 17       | 55.0     | 12       | 39.0     | 8        | 25.8     |
| Later                     | +ve   | 35    | 27       | 77.1     | 22       | 62.8     | 19       | 54.3     |
|                           | -ve   | 28    | 16       | 57.1     | 15       | 53.5     | 12       | 42.8     |
| Control                   | ..    | 61    | 9        | 14.8     | 4        | 6.6      | 0        | 0.0      |

the 57th day, when it was 1 in 100; (iii) never above 1 in 100 which it reached on the 17th and 34th days; (iv) never higher than 1 in 100 which it reached on the 34th day; and (v) 1 in 400 throughout observation, but also 1 in 200 *Bact. paratyphosum B* and 1 in 400 *Bact. typhosum*.

In (i) the *Bact. typhosum* agglutination was also negative, and in (iv) it was only 1 in 50, but in the rest it was higher than the specific agglutination.

#### Comparison of bacteriologically positive and negative cases

*Maximum titre.*—In nearly every instance the bacteriologically positive cases show a higher percentage of positive Widal results, whether the O or the H antigens were used. The difference in the individual groups is often not significant, but grouped together it becomes very significant.

Any fallacy that might arise through the Widal reaction influencing the diagnosis in these bacteriologically negative cases would lead

TABLE IV : Showing the time of peak of the agglutination curve

|                   | 1st week | 2nd week | 3rd week | 4th week | 5th week | 6th week | 7th week<br>and up |
|-------------------|----------|----------|----------|----------|----------|----------|--------------------|
| O-agglutination { | Positive | 3        | 7        | 8        | 6        | 7        | 4                  |
|                   | Negative | 3        | 9        | 11       | 5        | 3        | 3                  |
| H-agglutination { | Positive | 1        | 5        | 9        | 4        | 7        | 4                  |
|                   | Negative | 1        | 3        | 10       | 4        | 2        | 3                  |

*The peak of the agglutination curve.*—Table IV shows the time of the highest points in the O-agglutination curve in 35 bacteriologically positive and 34 bacteriologically negative cases. In both graphs the highest point is in the 4th week. With the H-agglutination the peak is in the 4th week in 35 bacteriologically positive cases and in the 3rd week in 27 bacteriologically negative ones.

to the selection of cases with a high Widal reaction in this group.

*Conclusion.*—Taking both the facts presented above into consideration, the finding of a lower agglutination in the bacteriologically negative cases does seem to suggest that they were perhaps not all cases of enteric. As, however, particularly in the later weeks, the difference between the percentages of positive Widal's in the two groups



is very small, it is apparent that, even if we give this interpretation to the observation, not many non-enteric cases were included.

*Comparison between the Widal in the control group and in the enteric cases at different weeks*  
*O-agglutination*

The lowest possible dilution it would be worth considering is 1 in 100. In the control group 44 per cent were positive in this dilution. If this is compared with the percentages in table II-a, it will be seen that during the 1st week 70 per cent were positive in this dilution, but the numbers are few so that the difference is not significant. In all the later weeks the difference is significant, but with 44 per cent positive in the control group a Widal in this dilution is only of negative value.

At a dilution of 1 in 200 the percentage of positive Widal in the controls drops to 23 per cent and is never lower than 60 per cent in the bacteriologically positive group: the differences are all significant, but with a 1 in 4 (almost) chance of a false positive, the value of a positive result is still not high.

At a dilution of 1 in 400 only 8 per cent are positive in the control group, whereas in the bacteriologically positive cases the percentage of positive cases rises from 17 in the 2nd week to 48 per cent in the 3rd, 67 per cent in the 4th, to a maximum of 78 per cent after the 4th week.

*Controls with positive Widal.*—There were five of these:—Case (i) was a case of malaria in which there is no record of his having been inoculated, but he was also positive in a high dilution to paratyphosus A and B as well as to typhoid, so the chances are that he had been inoculated, case (ii) was a doctor who had possibly previously had typhoid and now had cholecystitis, case (iii) was also a doctor and had cholelithiasis (a few days later the Widal was positive 1 in 100 only), case (iv) was a medical student (positive 1 in 400) with influenza, and case (v) had a very obstinate macrocytic anemia (positive 1 in 800).

*Bacteriologically positive cases with low-titre Widal late in disease.*—There were six cases in this category:—Case (i) was negative up to the 32nd day, case (ii) showed a very late rise and was positive 1 in 100 in the 9th week, case (iii) was positive 1 in 100 in the 10th week but later rose to 1 in 800, cases (iv) and (v) were positive 1 in 100 only after the 4th week, but during the 4th week with 1 in 200 and 1 in 400, respectively; that is, the titre was falling, case (vi) seems to have been a carrier (*paratyphosus A*) for he was clinically not enteric nor was the Widal ever more than 1 in 100.

*Conclusion.*—As with the O antigen a positive Widal 1 in 200 may occur in one non-enteric case in four, a Widal result of this calibre though suggestive is not of very great positive diagnostic importance.

A 1 in 400 agglutination only occurred in 8 per cent of controls in the first examination, so that a Widal result of this calibre has a very considerable diagnostic value; it occurred in 20 per cent of bacteriologically positive cases in the 2nd week, 52 per cent in the 3rd, 70 per cent in the 4th and in 77 per cent after the 4th week.

The difference between 8 per cent and 21 per cent is not significant, but in the 3rd and

subsequent weeks the difference is very significant.

As the Widal was positive in a 1-in-200 dilution in the 1st and 2nd weeks in 72 per cent of cases, a negative reaction in this dilution is suggestive but not strong evidence against a diagnosis of enteric; by the 4th week however only one in eight cases of the bacteriologically diagnosed enteric cases failed to reach this titre, so that a negative Widal in this titre at this stage has a considerable negative value.

A negative Widal at 1-in-100 dilution occurred in only three cases after the 3rd week; one was apparently a carrier of *Bact. paratyphosum A*, another was positive at a higher titre earlier in the disease, and the third was negative up to the 32nd day. Thus, very great negative value can be attached to a continuous negative Widal at this dilution, but it does not entirely exclude enteric.

*H-agglutination*

H-agglutination 1 in 100 is positive in the control series in 9 out of 61 cases (14.8 per cent) and in the bacteriologically positive group in 3 out of 10 cases (30 per cent) in the 1st week and in 58.6 per cent in the 2nd week. The difference between the controls and the 1st week results is not significant, but between the control and the subsequent weeks' results it is very significant.

H-agglutination at 1 in 200 was only found in 6.6 per cent of the controls, in 20 per cent of the bacteriologically positive cases in the first week, 48.2 in the 2nd and in higher percentages later; the percentages in the 2nd week and later are very significantly greater than in the controls.

In a dilution of 1 in 400 no H-agglutination was positive in the control series, and in the bacteriologically positive cases the percentages were 10, 13.7, 32.2 and 48.2 per cent in the 1st to 4th weeks; all these percentages are significantly higher than the nil percentage of the control cases.

*Conclusion.*—H-agglutination 1 in 100 is suggestive, as less than 15 per cent of controls gave this agglutination; at 1 in 200 it is strongly suggestive, and at 1 in 400 practically diagnostic of enteric.

As, however, even at 1 in 100 in the 3rd and 4th weeks the H-agglutination is negative at least once in four times, a negative test at this dilution is not of any great value.

*Summary of conclusions on the diagnostic value of the Widal reaction.*—Thus, we could say that a positive O-agglutination of 1 in 400 or H-agglutination of 1 in 200 is very suggestive, an H-agglutination of 1 in 400 practically diagnostic of enteric, and that a negative O-agglutination at a dilution of 1 in 100 in the 2nd or 3rd week or one at a dilution of 1 in 200 in the 4th week are strong evidence against enteric. As the H-agglutination failed to rise to a titre of 1 in 100 in 25 per cent of enteric cases

in the 4th or later weeks, a negative reaction in this titre is of little diagnostic significance.

*Rising titre.*—A 'two-tube' increase was reported in 21 (TH) and 32 (To) in the bacterially positive cases, and in 15 (TH) and 22 (To) in the negative ones.

*Specific value.*—In two out of the three blood-positive paratyphoid cases, *Bact. paratyphosum*

patient, furnishes about 2,000 calories, and represents a minimum. The daily intake of protein is about 60 grammes (roughly one gramme per kilo body-weight). Fat supplies 20 to 25 per cent of the total calories. The rest of the energy is furnished by carbohydrates; it is given as lactose (less sweet and does not produce gas), dextrin, glucose and/or sugar in the order

TABLE V : Summarizing the conclusions on the interpretation of the Widal test

|                 | Positive diagnosis | Negative diagnosis                     | Significance          |
|-----------------|--------------------|--|-----------------------|
| O-agglutination | Positive 1 in 200  | Negative 1 in 200 in 1st and 2nd week  | is suggestive.        |
|                 | " 1 in 400         | " 1 in 200 in 4th week or later        | is very suggestive.   |
|                 | " ..               | " 1 in 100 in 2nd or 3rd week          | is very suggestive.   |
|                 | " ..               | " 1 in 100 in 4th week                 | is almost conclusive. |
| H-agglutination | Positive 1 in 100  | Negative 1 in 100 in 3rd week or later | is suggestive.        |
|                 | " 1 in 200         | " ..                                   | is very suggestive.   |
|                 | " 1 in 400         | " ..                                   | is almost conclusive. |
|                 | " ..               | " ..                                   |                       |

H-agglutination was higher than the corresponding *typhosum* agglutination and on the third day they were equal, whereas in all three the *typhosum* O-agglutination was the higher.

In the 26 bacteriologically positive typhoid cases, all H-agglutinations were negative in 2; of the rest the H-agglutination was higher with *Bact. typhosum* than with the *Bact. paratyphosum* A or B in 22 cases, and equal to one another in two. Whereas the O-agglutination was highest with *Bact. typhosum* in 23 cases, highest in *Bact. paratyphosum* A in two, and equal with *Bact. typhosum* or *Bact. paratyphosum* B in one.

Both these observations suggest a greater specific value for the H-agglutination; this fact is usually accepted.

#### TREATMENT

The treatment was mainly dietetic and symptomatic; in a few cases certain specific treatments were superimposed, of which details are given.

*Diet.*—Practically every adult patient was given the diet shown in table VI. We seldom had occasions to reduce it in any case of the bacteriologically diagnosed group; on the contrary there were many instances in which we extended the diet, especially in the later stages of the illness, by incorporating egg-flip, jelly, thin bread and butter, biscuits, mashed potatoes, etc., the consumption of some solids was encouraged early in order to maintain mouth sanitation. If for some reason a reasonable amount of diet could not be given, glucose was administered parenterally as a supplement.

The amount of food required obviously varies in the individual case, the points considered are the patient's dietetic habit, his weight, appetite, degree of toxæmia, etc.

This diet, which was designed to meet the lower requirements of the average Indian

of preference. Plenty of water is given between feeds; *dab* or barley water may be preferable for private patients.

Unless there are definite contra-indications, such as tympanites or severe toxæmia, the patient is pressed to take the full dietary quota; high fever, slight toxæmia, lack of appetite, etc., which are the usual symptoms of the disease, are not looked upon as excuses for starving the patient.

As the convalescence began, the diet was gradually increased by addition of eggs, bread and butter, etc., if these had not already been given, and thereafter, the patient was given fish, soft rice, and puddings until a full diet was attained.

TABLE VI : Typhoid diet

| Article      | Quantity | Protein | Fat  | Carbo-<br>hydrate | Calories |
|--------------|----------|---------|------|-------------------|----------|
|              |          | Grammes |      |                   |          |
| Milk ..      | 40 oz.   | 37.5    | 41   | 54.5              | 720      |
| Chicken soup | 4 oz.    | 12      | 1    | 2                 | 65       |
| Oranges ..   | 6        | 4.5     | 0    | 40.5              | 180      |
| Sugar ..     | 4 oz.    | 0       | 0    | 113               | 452      |
| Glucose ..   | 4 oz.    | 0       | 0    | 113               | 452      |
| Bread ..     | 2 oz.    | 4       | 0.5  | 30                | 140      |
|              |          | 58      | 42.5 | 353               | 2,009    |

#### Feeds

- 6 a.m.—Milk (8 oz.) with sugar (3 teaspoonfuls).
- 8 a.m.—Glucose (1½ oz.) with sufficient water.
- 10 a.m.—Milk (8 oz.) and bread (2 oz.) with sugar (4 teaspoonfuls).
- 12 noon.—Orange juice (6 oranges) with glucose (1 oz.).
- 2 p.m.—As at 6 a.m.
- 4 p.m.—Glucose (1½ oz.) with sufficient water.

6-30 p.m.—Chicken soup (4 oz.).

10 p.m.—As at 6 a.m.

During night.—As at 6 a.m.

*Symptomatic treatment.*—A simple alkaline diaphoretic mixture was given to all patients. Constipation (present in the large majority) was dealt with by a simple enema on alternate days, with or without liquid paraffin by mouth. Moderate diarrhoea was encountered in a few cases; this usually responded to some modification of diet, such as the substitution of peptonized milk or whey for ordinary milk. Some had Mellin's food. A chalk mixture, or bismuth with Dover's powder, or a starch and opium enema at night was given in a very few cases in which it was necessary.

For meteorism, turpentine stipes to the abdomen, with or without oil of cinnamon by mouth, was found sufficient in most cases. The milk was citrated or peptonized and glucose was reduced or replaced by lactose or dextrin. A few cases were given fractional doses of calomel with good result. None required injections of pituitrin or eserine.

Hyperpyrexia was usually combated by hydrotherapy. To ensure sleep at night bromides or phenobarbitone were given whenever required. The more seriously ill patients with feeble pulses were given brandy and intravenous glucose. A few had 5 per cent glucose saline by the drip method; others had cardiazol, coramine, or camphor-in-oil injections. None had injections of suprarenal cortical extract.

Retention of urine, which occurred in a few cases, responded to applications of a hot-water bag over the bladder and a warm enema, but often a change of posture was sufficient. Catheterization was rarely necessary.

Quinine was given in five cases—three of the positive and two of the negative series—during what should have been the convalescence period of illness, as they were running irregular intermittent temperatures. Quartan parasites were found in one case. The temperature was readily controlled in all of them. Six patients had quinine in the earlier stages of the illness before a diagnosis was made, presumably as a therapeutic test to exclude malaria. Except for perhaps a slight temporary febrile action, the drug had no effect on the fever.

### Specific treatment

Anti-typhoid serum was used in three patients; two had 30 c.cm. intramuscularly for three consecutive days. In the other, which was the only really severe toxic case in the 'positive' series, an Indian boy aged 8, Felix's Vi anti-typhoid serum was given in doses of 20 c.cm., 40 c.cm. and 40 c.cm. on three consecutive days; he was unconscious when the first dose was given and at the third dose had a violent reaction and became pulseless, but we believe that the treatment determined the turning point in the disease and eventually he recovered.

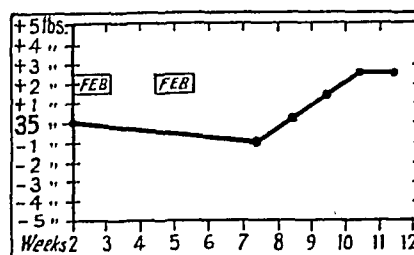
*Typhoid 'phage* was given to eight patients, in one case intravenously in a minute dose. There was no evidence that this influenced the course of the disease to the slightest degree.

Sulphapyridine was given to eight cases, pron-tosil to one and sulphanilyl-guanidine to one case; no significant effect was observed.

*Hospital routine.*—All the patients were treated in the open wards; the usual 'typhoid precautions' were taken and no secondary cases occurred.

Just before discharge the faeces and urine were examined in the bacteriological laboratory at least three times; no carriers were detected.

*Results of treatment.*—Few of our patients lost weight during treatment and those who did regained it before leaving hospital.



Typical weight chart. The patient was admitted at end of second week and had a relapse; 'FEB' indicates the febrile periods.

Relapses occurred in seven cases (see below).

There were no serious complications, such as hæmorrhage or perforation; but in one case there was apparently slight bleeding from an ulcer; the blood was only detected in the stools on one day.

There were no deaths in the positive series and two deaths in the negative series; all the patients remained in hospital until convalescence was established.

### Relapses

Relapses occurred in seven cases—five of the positive and two of the negative series—the percentage relapse rate thus being 9 only. The number of days of apyrexia after which the relapse occurred was:—

|                  | Positive series | Negative series |
|------------------|-----------------|-----------------|
| Under 5 days ..  | 0               | 1               |
| 5 to 10 days ..  | 4               | 1               |
| 11 to 15 days .. | 1               | 0               |
|                  | 5               | 2               |

The relapse occurred on an average on the ninth day of normal temperature; the earliest was on the third day and latest on the fifteenth day.

The febrile period of the relapses varied from 7 to 17 days as shown below :—

|                  | Positive series | Negative series |
|------------------|-----------------|-----------------|
| 7 to 10 days ..  | 2               | 2               |
| 11 to 17 days .. | 3               | 0               |
|                  | 5               | 2               |

The type of temperature was remittent in all cases except one—

|                    | Positive series | Negative series |
|--------------------|-----------------|-----------------|
| Remittent fever    | 4               | 2               |
| Intermittent fever | 1               | 0               |
|                    | 5               | 2               |

All had a slow rise and in all the temperature fell by lysis.

The bowels were constipated in five cases; none had diarrhoea.

*Complication.*—Only one of these patients had a recurrence of phlebitis that he had had during the original attack. The course was uneventful in all other cases during the relapse. None had more than one relapse. All of them recovered.

The *causative organisms* were isolated from the blood in four cases and from the urine in one case during the relapse. During the original attack the blood was positive in one and the stools in four of these patients.

#### Widal reactions

|                        | 'O' agglutination | 'H' agglutination |
|------------------------|-------------------|-------------------|
| Further rise in titre— |                   |                   |
| Positive series ..     | 5                 | 2                 |
| Negative " ..          | 1                 | 1                 |
| Fall in titre—         |                   |                   |
| Positive series ..     | 0                 | 3                 |
| Negative " ..          | 1                 | 1                 |

#### DISCUSSION

*Enteric in India.*—Fifty years ago typhoid was never diagnosed in Indians, and it was, therefore, not understood why it was so common amongst Europeans, especially amongst European soldiers. This failure to diagnose typhoid in Indians is not easy to explain, in view of the fact that it is a very common disease amongst Indians today. The authors' view is that in the past it was probably a very common disease in childhood when it escaped diagnosis, and that adults were therefore protected by their previous experience. Now that India has enjoyed two generations of improved sanitation, typhoid is

rarer in childhood and therefore commoner in adult life when it is more easily recognized.

To-day it is certainly widely prevalent amongst Indians in this country, and it sometimes breaks out in epidemic form. For instance, 'from Bombay presidency about 5,000 to 8,000 cases of enteric fever are reported every year and Bombay city accounts for more than 2,000 cases out of them. There were two widespread epidemics here, one in 1937 and another in 1938' (Sulakhe, 1941). According to the *Calcutta Municipal Gazette, Health Number*, 1940, the death rate from typhoid in Calcutta during a period of 10 years (1927 to 1937) was on an average 0.78 per mille. It broke out in epidemic form in a Calcutta hotel in 1938. Outbreaks were reported in Delhi in 1935. There was a small outbreak of 13 cases of paratyphoid A in Lahore district in 1940.

*The severity of the disease in India.*—The writers are impressed by the fact that the disease tends to be milder in Indians than in Europeans, though many will not agree with this. Our experience reported above certainly supports this view for we had no deaths in 38 bacteriologically diagnosed cases and only two in the whole series of 77, that is a mortality of less than 3 per cent.

On the other hand, newly arrived foreigners are liable to be more dangerously ill as a result of infection with local strains of organisms. Thus, Murray (1938) reported a large percentage of serious cases amongst 31 European patients admitted into the Presidency General Hospital, Calcutta, following a typhoid outbreak in an hotel.

*Incidence of paratyphoid infection.*—The relative frequency of the various enteric infections in India does not seem to have been clearly established. Manson-Bahr (1940) writes 'paratyphoid is the most common infection in the East (India, etc.)'. Box (1937) states that paratyphoid A is prevalent in India and other tropical countries. Lakin (1937) also holds the same view. Yodh (1937) reporting on 60 cases stated that *Bact. typhosum* was the causative organism in most of the cases. Minchin (1939) found only three cases of paratyphoid A and two of paratyphoid B among 444 cases of enteric fever. Sulakhe (*loc. cit.*) in a series of 75 cases considered all cases except one to be due to infection by *Bact. typhosum*. Others in this country have found a higher percentage of paratyphoid A cases, but never above 16 per cent of the total enteric cases.

In the present series, five were cases of paratyphoid A infection, an incidence of 13 per cent, among 38 patients from whom the organisms were actually isolated. In none was paratyphoid B found.

Thus, while there is no support for the view of the majority of the statements in British textbooks, that paratyphoid A is the common enteric infection in India, it does seem possible that there are many more cases of paratyphoid

fever than are diagnosed. A much lower agglutination titre is obtained with the para-typoid organisms than with *Bact. typhosum*, and in our bacteriologically positive series, the para-typoid titre of the O-agglutination did not rise above 1 in 100, except in one case though the H-agglutination was 1 in 800. It will be seen that on the Widal reaction alone not a single case was diagnosed. Karunakaram and Pillai (1942) believe that many cases are missed through failure to do early blood cultures, and bring evidence in support of their, and our, opinion.

*Season.*—The maximum number of patients of this series were admitted in the month of July; cases however came at all times of the year. Sulakhe (*loc. cit.*) obtained the maximum incidence in June, July and August.

*Culture.*—Although it is commonly stated that the bacterial culture of blood for enteric organisms is only positive in the first ten days, organisms may be isolated much later in the disease. Minchin (*loc. cit.*) reported positive blood cultures in 50 per cent of his cases; 11 per cent were positive after 15 days of illness. Murray (*loc. cit.*) obtained a positive blood culture in one case six weeks after the commencement of illness. In our series the causative organisms were isolated in almost half the cases; the blood was positive in 37.6 per cent and the stools in 24.6 per cent cases. In nine cases the blood culture was positive in the 1st week, in 11 during the 2nd week, and in 11 later than the 2nd week.

*Diagnosis on the Widal reaction.*—Minchin (*loc. cit.*) takes a Widal of 1 in 200 dilution as positive evidence of typhoid. Lewin (1938) considers that in an uninoculated person a 1 in 100 H- and a 1 in 200 O-agglutination give a diagnostic error of 3 per cent.

The comparative study of our Widal results of enteric and non-enteric cases shows that, in the population with which we deal, mostly uninoculated, a positive H-agglutination of 1 in 100 is suggestive, 1 in 200 is very suggestive and 1 in 400 is almost conclusive, while a positive O-agglutination of 1 in 200 is suggestive and 1 in 400 is very suggestive of enteric diagnosis.

The H-agglutination has a greater positive value, but a negative H-agglutination is of little significance as the H-agglutinins may fail to appear. On the other hand, a negative O-agglutination, or one positive only at 1 in 200, in the later weeks is strong evidence against enteric. A far more significant point in the diagnosis by Widal reaction is an early negative or weakly positive result, with a subsequent steady rise in titre.

*Mortality.*—The death rate in Minchin's series was 13.7 per cent and in that of Sulakhe 25 per cent. Rajoo (1942) reported a death rate of 20.22 per cent in 356 cases. Minchin included three groups of patients on different diets. The mortality rate did not differ much between these groups, but the cases in the high calorie-diet

group showed least complications. The high mortality in Sulakhe's series was probably due to the fact that most of the cases came to the hospital late in the course of the disease; five cases came with serious complications and died within 48 hours after admission.

In the present series, the mortality is 2.6 per cent.

*Complications.*—The absence of serious abdominal complications is also a notable feature in this series. Only one patient had slight bleeding from the bowel; none had perforation. Both Minchin and Sulakhe reported hæmorrhages in 3.6 and 4 per cent of their cases, and perforation in 0.9 and 2.6 per cent respectively. Rajoo (*loc. cit.*) reported 23 cases of hæmorrhage, 11 of which were fatal in a series of 356 cases. Murray had two cases (6.4 per cent) of fatal hæmorrhage.

Thirteen per cent of our cases had definite tympanites, while Minchin's percentage was only 11.5.

*Relapses.*—A relapse occurred in 9 per cent of our cases, while Minchin and Sulakhe had 6.5 and 5 per cent, respectively.

*Possible causes of the rarity of complications and the low mortality.*—These seem to call for some comment. No claim can be made for the efficacy of any specific treatment, with the possible exception of the action of serum in one very severe case; few cases caused us any anxiety during the course of the disease and, as noted, none had serious complications.

The nursing was good, probably as good as that in any of the best hospitals in India, but in some of the other published series with higher death rates the nursing was also good.

This brings one to the question of diet. There is a deeply ingrained, and in our experience, quite inexplicable, prejudice in this country against a liberal diet in typhoid fever. The high-calorie diet was started after the Boer war when, the story has it, all the typhoid cases in Ladysmith during the siege were fed on 'bully beef' and did remarkably well. The high-calorie diet was placed on a more scientific footing by Coleman (1909) and other workers, and it has been the practice in America for over thirty years. In Great Britain there has been little typhoid, except for a few recent outbreaks that obtained much publicity, for the last three decades, so that textbooks were slow to revise their teaching; nevertheless, most standard textbooks now advocate a liberal diet.

The rationale of the high-calorie diet is shortly this :—

The continuous temperature puts up the metabolic requirements of the patient by about 40 per cent. If he is not given a liberal diet he will have to live on his own tissues; superfluous tissues are soon exhausted, so that he has to burn vital tissues, and one of the earliest calls is on muscle, including the intestinal muscle; when this is reduced blood vessels are laid bare and the peritoneum is left without support, so that both hæmorrhage and perforation are likely

to occur. A liberal diet should obviate this and in practice it has been repeatedly shown that it does so.

The main objection raised against the high-calorie diet, that the waste products of protein metabolism are toxic substances which add to the already existing toxæmia, is more theoretical than real. The objection to the giving of solids, namely that they are likely to push their way through ulcers, entirely ignores the physiological fact that digestible pieces of solid food do not pass through the pylorus in this state, but, if in solid form at all, as a fine emulsion. The argument that the digestive functions are depressed in fever is also without foundation.

Of the truth of the oft-repeated objection that relapses are more common when a liberal diet is given, we are unconvinced by practical experience, though our relapse rate was slightly higher than that of some other physicians; it is better to have a relapsing patient than a dead one, even if feeding does increase the relapse rate, and in our experience relapses have always been even milder than the original attack.

As modern teaching cannot be ignored, many physicians in this country profess to give a high-calorie diet, but in actual practice always find some excuse for modifying it. It is necessary to be very firm both with the patient, who seldom has any inclination to take food, and with the nursing staff, who are inclined to pander to the patient, and his relatives. Constant encouragement is often necessary to make a patient take his full diet, especially if it is a monotonous fluid diet; he will often welcome the variety provided by solids, such as toast, bread and butter, or biscuits, and soft puddings. There will of course be occasions when tympanites may make some modification, and even temporary reduction, essential, but in our experience the judicious use of purgatives, such as small doses of calomel, at any stage of the disease reduces the frequency of these occasions.

Although our hospital typhoid diet is only 2,000 calories, we believe that on the average every adult patient took the full diet on nine days out of ten during the whole febrile period, and that many took much more than this. Thirty-eight consecutive cases without a death indicates a maximum death rate of 7.6 per cent (on the usual 0.05 significance level); nevertheless, we do not feel that we can claim that these deviations from the usual practice in this country can have accounted for the more benign courses that most of our cases ran.

Other possible explanations are that this hospital is not an emergency one, so that the desperately ill cases, which for example helped to swell Sulakhe's death rate, are seldom admitted, that as in our hospital blood cultures are taken as a routine in nearly all febrile cases on admission we diagnosed a large number of

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## CHOLESTEROL AND ANÆMIA

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### PART I

#### BLOOD CHOLESTEROL CONTENT OF ANÆMIC INDIANS

A CONSIDERABLE amount of work has been done on variations of blood cholesterol in different diseases, and it has been considered that the blood cholesterol content might be a useful guide for diagnostic purposes. Thus, cholesterol estimations are useful in the diagnosis of xanthematoses, and nephrosis. Under these conditions, and in some cases of pregnancy and diabetes, the blood cholesterol increases, while in pernicious anæmia and secondary anæmias (Muller, 1930; Muller and Heath, 1933; Chatterjee and Ghosh, 1938; Benda, 1924; Bloor and MacPherson, 1917; Denis, 1917; Donomae, 1927; Dubin, 1918; Feigl, 1919; Köhn, 1925; MacAdam and Shiskin, 1923; Stepp, 1918) the blood cholesterol falls.

(Continued from previous column)

mild cases than is usual in hospitals in India, or that some of the fatal cases, clinically diagnosed as enteric, are really other blood infections of a more severe nature, e.g., *Bacterium metalkaligenes* or *Alkaligenes faecalis* infection.

**Acknowledgment.**—We acknowledge the help we received from the bacteriological department of the School and are particularly grateful to Dr. K. P. Banerjee for his assistance in extracting data.

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In the present state of our knowledge it is rather difficult to say to what these variations in cholesterol are due, nor do we know the part played by cholesterol in the defence mechanism of the body. Chatterjee (1940) draws attention to the possible protective rôle of cholesterol in erythropoietic tissues and in support of this he claims to have treated successfully thirteen cases of advanced macrocytic hyperchromic anæmia of pregnancy with intramuscular injections of cholesterol. In view of this observation of Chatterjee it was thought of interest to try this simple treatment in a larger number of cases of

anæmia of pregnancy at the Lady Hardinge Hospital, and with this idea in view the present investigation was undertaken.

The data presented in part I of this paper relates to the hæmatological and biochemical findings with anæmic blood and for comparison figures for blood cholesterol obtained for normal and normal pregnant women are incorporated. The second part of this paper will deal with the results obtained with cholesterol therapy in anæmia. The results are presented in table I. Blood cholesterol was estimated by the method of Myers and Wardell (1918)

TABLE I

*Initial blood count*

| Case number | Red cells millions | Hæmo-globin Sahli units | MCV cu. $\mu$ | Serum cholesterol mg. % | Serum proteins gm. % | REMARKS  |
|-------------|--------------------|-------------------------|---------------|-------------------------|----------------------|--|
| 1           | 0.5                | 12                      | 145           | 51.6                    | ..                   | Primigravida, 30 weeks pregnant.   |
| 2           | 2.1                | 30                      | 115           | 101.2                   | ..                   | 2nd para, 30 weeks pregnant with mild osteomalacia.  |
| 3           | 0.74               | 15                      | 109           | 83.4                    | ..                   | 10th para, 30 weeks pregnant.  |
| 4           | 1.6                | 32                      | 126           | 100                     | ..                   | 7th para, 28 weeks pregnant.   |
| 5           | 1.63               | 28                      | 109           | 20                      | ..                   | Primigravida, 24 weeks pregnant, admitted with acute bacillary dysentery and splenomegaly.     |
| 6           | 1.2                | 29                      | 145           | 36.9                    | 6.05                 | Primigravida, 38 weeks pregnant, loose stools, ankylostomiasis.                                |
| 7           | 1.3                | 28                      | 102           | 43.4                    | ..                   | 7th para, 32 weeks pregnant.   |
| 8           | 2.1                | 36                      | 102           | 133                     | ..                   | 4th para, 38 weeks pregnant.   |
| 9           | 1.7                | 40                      | 115           | 81.6                    | ..                   | 5th para, 32 weeks pregnant.   |
| 11          | 2.86               | 60                      | 104           | 52.6                    | 7.6                  | 5th para, 28 weeks pregnant.   |
| 14          | 1.9                | 45                      | 77            | 66                      | 7.8                  | 14th para, 30 weeks pregnant.  |
| 15          | 3.6                | 58                      | 81            | 173                     | ..                   | Primigravida, 30 weeks pregnant.   |
| 16          | 2.07               | 33                      | 100           | 58.8                    | 6.25                 | 8th para, 26 weeks pregnant, complicated by ankylostomiasis.                                   |
| 19          | 2.7                | 45                      | 94            | 90.9                    | 8.9                  | Primigravida, 20 weeks pregnant, complicated by pulmonary tuberculosis.                        |
| 21          | 3.45               | 34                      | 64            | 108                     | ..                   | Primigravida, 30 weeks pregnant.   |
| 22          | 0.77               | 15                      | 155           | 25                      | 7.5                  | 4th para, 26 weeks pregnant. Febrile: ?mild urinary infection.                                 |
| 24          | 0.72               | 17                      | 168           | 121.2                   | 6.4                  | 3rd para, 8½ months pregnant.  |
| 25          | 1.08               | 25                      | 100           | 57                      | ..                   | 7th para, 32 weeks pregnant, premature delivery on admission, malaria and bacillary dysentery. |
| 29          | 1.2                | 19                      | 109           | less than 20            | ..                   | 8th para, 28 weeks pregnant, fever and cough from 3 weeks, diarrhoea.                          |
| 31          | 1.6                | 20                      | 48            | less than 20            | ..                   | Primigravida, 4½ months pregnant, ankylostomiasis, heavy infection.                            |
| 37          | 2.4                | 48                      | 66            | 81                      | ..                   | 18th para, 24 weeks pregnant, bleeding piles.  |
| 43          | 1.56               | 24                      | 108           | 55.5                    | ..                   | Delivered 5 months before admission.   |
| 44          | 1.42               | 26                      | ..            | 45.4                    | ..                   | Non-pregnant, chronic diarrhoea, hypochlorhydria.  |
| 45          | 0.59               | 8                       | 110           | 39.2                    | 9.37                 | Non-pregnant, tropical macrocytic anæmia, splenomegaly, chronic malaria.                       |
| 46          | 1.17               | 23                      | 99            | 22.1                    | ..                   | Non-pregnant, tropical macrocytic anæmia, malaria.   |
| 48          | 0.93               | 9                       | 84            | 27.5                    | 9.37                 | Non-pregnant, macrocytic hypochromic anæmia, malaria, irregular menstrual periods.             |
| 49          | 0.97               | 10                      | 73            | 20                      | 4.9                  | Non-pregnant, microcytic hypochromic anæmia, ankylostomiasis.                                  |

*Normal serum cholesterol*

| <i>Pregnant</i> |         |       | <i>Non-pregnant</i> |         |       |
|-----------------|---------|-------|---------------------|---------|-------|
| Maximum         | Minimum | Mean  | Maximum             | Minimum | Mean  |
| 247             | 112     | 179.5 | 152                 | 100     | 126.0 |

employing 1 c.cm. of blood serum and serum proteins were determined by the micro-kjeldahl method employing direct nesslerization.

*Discussion.*—A glance at the table shows that the blood cholesterol content of normal Indians is lower than that of Europeans. These results are in keeping with the findings of Boyd and Roy (1928), Ghose (1933) and Bose and De (1936) on normal blood cholesterol content. Whether these lower values are due to climatic conditions, or lower cholesterol content of the diet, is difficult to say. Most of my blood cholesterol figures for anæmic patients are comparable with those of Chatterjee (1940), but there are a few cases where my figures are extremely low. All these cases were suffering from a coincident complication of bacterial, protozoal or helminthic infection. These findings confirm the findings of other workers (Achard *et al.*, 1928; Okey and Boyden, 1927; Mcquarrie and Stoesser, 1932; Marino, 1933) that cholesterol appears to be regularly lowered in febrile infectious diseases. In the majority of acute infectious diseases, such as pneumonia, cholesterol is reduced at the height of the disease, returning to normal during convalescence (Denis, 1917; Kipp, 1920; Stepp, 1918).

In syphilis (Rosen and Karsnow, 1926), leprosy (Boyd and Roy, 1928) and tuberculosis (Eichelberger and McCluskey, 1927; Henning, 1922), it has also been found to be somewhat low.

In view of these findings one is led to conclude that cholesterol plays an important part in the defence mechanism of the body, but whether the fall of blood cholesterol is a cause or result of infection it is difficult to say. Cases of secondary anæmia investigated by me were very few, but the blood cholesterol estimations in these were found to be as low as in cases of pregnancy anæmia, cases with extremely low blood cholesterol again having a coincident infection. These findings seem to support the Bodanskys' (1940) suggestion that the factor affecting blood cholesterol content may be some disturbance of the reticulo-endothelial system rather than the red cell and hæmoglobin content of the blood.

#### *Summary and conclusions*

1. Blood cholesterol in Indians is lower than that in Europeans.
2. Blood cholesterol in patients suffering from anæmia is low irrespective of the type of anæmia.
3. Level of blood cholesterol does not seem to run parallel with the red cell count and the hæmoglobin concentration of the blood.
4. Infections, bacterial, protozoal and helminthic, seem to lower still further the blood cholesterol content of anæmic persons.

## PART II

### CHOLESTEROL THERAPY IN ANÆMIA

Fifty-one cases of anæmia were investigated at the Lady Hardinge Hospital, Delhi. At first, I confined myself to cases of macrocytic hyperchromic anæmia in pregnancy, but later on some orthochromic normocytic and hypochromic microcytic cases of pregnancy anæmia and a few non-pregnant cases were also included for the sake of comparison.

Forty cases out of the 51 presented a macrocytic hyperchromic blood picture, five were orthochromic and normocytic, and the remaining six were hypochromic and microcytic. Of the macrocytic hyperchromic and normocytic orthochromic group of 45 cases, 41 were pregnant and four were non-pregnant. Five out of the pregnant group were normocytic orthochromic to begin with but became macrocytic and hyperchromic during their stay in hospital. Out of the six microcytic hypochromic cases, two were pregnant and four were non-pregnant\*.

*Investigations.*—A complete blood count was done on each case on admission and then regularly at weekly intervals in severe cases and at fortnightly intervals in less severe ones.

At first serum cholesterol and serum proteins were estimated in every case before putting the patient on anæmia treatment, but towards the end it became difficult to get chloroform so that some of the cases could not have their serum cholesterol estimated. Results of these estimations have been given in tabular form in part I of this paper.

*Therapy.*—At first all the cases were put on intramuscular injections of 5 per cent solution of cholesterol in olive oil, 2 c.cm. daily or on alternate days (cases 1 to 21 inclusive). Results were not encouraging, so that majority of the cases had to be shifted on to liver therapy. One of the early very severe cases died on the sixth day after admission. It was felt that she might have pulled through if she had been treated with liver injections from the beginning. Thereafter it was made a rule to put all cases with an initial red cell count under one million per c.mm. on hepatex injections from the start and change over to cholesterol therapy later when their red cell count had risen above one million.

The results of therapy are given in table II†.

\* Full case histories of these 51 cases have been given in the appendix to a thesis submitted to the Punjab University for the degree of M.D. in January 1941.

† There are certain anomalies in this table which were not noticed until too late to refer the matter to the author, *e.g.*, it is not clear why cases 21 and 37 appear twice, in the second instance under the heading 'microcytic hypochromic anæmia' which is certainly not descriptive of both of them.—EDITOR, I. M. G.

TABLE II  
Pregnant group

| Case number | INITIAL BLOOD COUNT |       |               | FINAL BLOOD COUNT |       |               | Stay in hospital, weeks | Treatment   | Puerperium                                | REMARKS   |
|-------------|---------------------|-------|---------------|-------------------|-------|---------------|-------------------------|---|---|---|
|             | RBC millions        | Hb. % | MCV cu. $\mu$ | RBC millions      | Hb. % | MCV cu. $\mu$ |                         |   |   |   |
| 1           | 0.5                 | 12    | 145           | 3.5               | 50    | 81            | 11                      | First cholesterol, then hepatex, then again cholesterol.  | Normal                                    | Deterioration on cholesterol during pregnancy. Rapid improvement on hepatex. Progress maintained on cholesterol after delivery.   |
| 2           | 2.1                 | 30    | 115           | 4.35              | 68    | 68            | 9                       | First cholesterol, then hepatex, then iron, cholesterol added to iron later.  | Normal                                    | Deterioration on cholesterol, slow improvement on hepatex during pregnancy. Rapid improvement on hepatex after delivery. Progress maintained on iron and cholesterol plus iron after delivery.        |
| 3           | 0.74                | 15    | 109           | 0.635             | 12    | ..            | 6/7                     | First cholesterol, then hepatex.  | Heart failure and death following labour. | Deterioration on cholesterol. Premature labour and death before liver therapy could be of help.   |
| 4           | 1.6                 | 32    | 126           | 2.9               | 46    | 109           | 9½                      | First cholesterol + iron, later hepatex + iron. Again cholesterol + iron for the second time, and later hepatex + iron again. | Still undelivered.                        | Deterioration on cholesterol and rapid improvement on hepatex observed both times.  |
| 5           | 1.63                | 28    | 109           | 2.02              | 35    | 95            | 13                      | First cholesterol, then hepatex.  | Puerperal sepsis, white leg.              | Deterioration on cholesterol during pregnancy and puerperium complicated by puerperal sepsis. Some improvement on hepatex in spite of puerperal sepsis.   |
| 6           | 1.2                 | 29    | 145           | 4.63              | 81    | 85            | 17                      | First cholesterol, then hepatex, then cholesterol again. Iron given all along.  | Puerperal sepsis.                         | Deterioration on cholesterol during pregnancy and septic puerperium. Satisfactory response to hepatex. After puerperal sepsis had cleared up there was satisfactory response to iron and cholesterol. |
| 7           | 1.3                 | 28    | 102           | 1.25              | 25    | 96            | 2½                      | First cholesterol, then hepatex.  | Went home undelivered.                    | Deterioration on cholesterol. Patient went home before effect of hepatex could be observed.   |
| 8           | 2.1                 | 36    | 102           | 1.77              | 34    | ..            | 4½                      | Cholesterol only  | Mild sepsis.                              | No response to cholesterol. Patient went away before response to another form of therapy could be tested.   |

TABLE II—*contd.*

| Case number | INITIAL BLOOD COUNT |       |               | FINAL BLOOD COUNT |       |               | Stay in hospital, weeks | Treatment   | Puerperium  | REMARKS  |
|-------------|---------------------|-------|---------------|-------------------|-------|---------------|-------------------------|---|---|--|
|             | RBC millions        | Hb. % | MCV cu. $\mu$ | RBC millions      | Hb. % | MCV cu. $\mu$ |                         |   |   |  |
| 9           | 1.7                 | 40    | 115           | 2.14              | 46    | ..            | 3                       | Cholesterol only, later iron added.   | No sepsis   | Delivered on the day of admission. Response to cholesterol in puerperium seen.   |
| 10          | 1.18                | 23    | 102           | 2.27              | 42    | ..            | 2½                      | Cholesterol only  | Normal  | Delivered on the day of admission. Response to cholesterol in puerperium seen.   |
| 11          | 2.86                | 60    | 104           | 4                 | 65    | 85            | 7                       | Cholesterol only, then iron + cholesterol, then hepatex only, lastly iron only. | Normal  | Poor response to cholesterol and cholesterol + iron during pregnancy. Satisfactory response to hepatex, and after delivery to iron.  |
| 12          | 2.01                | 41    | 85            | 3.12              | 45    | 80            | 9½                      | First cholesterol only, then cholesterol and iron, later hepatex + iron.        | Puerperal sepsis.   | Patient's condition deteriorated on cholesterol during pregnancy and septic puerperium. Blood picture became macrocytic. There was rapid improvement on hepatex.   |
| 13          | 2.9                 | 48    | 80.3          | 3                 | 47    | 76            | 9½                      | Cholesterol first, later hepatex.   | Flaring up of tuberculous infection of lungs and abdomen. | Case of pregnancy and pleurisy with effusion and anæmia. Deterioration of blood condition on cholesterol, blood picture became macrocytic and hyperchromic. Improvement on hepatex in spite of the chest complication.                                       |
| 14          | 1.9                 | 45    | 76            | 3.4               | 50    | 73            | 9                       | First cholesterol, later hepatex.   | Went home undelivered.                                    | Came with bacillary dysentery, improvement of blood count at first probably due to spontaneous improvement after dysentery had subsided. Later deterioration on cholesterol, blood picture became macrocytic and hyperchromic. Slow improvement on hepatex.  |
| 15          | 3.6                 | 58    | 81            | 3.96              | 65    | 82            | 11½                     | First cholesterol only, then cholesterol + iron, then hepatex + iron.           | Normal  | Poor response to cholesterol and iron, slight deterioration on cholesterol alone. Response to hepatex + iron too was unsatisfactory while the pregnancy continued, but there was no further deterioration, better response to hepatex + iron after delivery. |

TABLE II—*contd.*

| Case number | INITIAL BLOOD COUNT |       |               | FINAL BLOOD COUNT |       |               | Stay in hospital, weeks | Treatment  | Puerperium                            | REMARKS  |
|-------------|---------------------|-------|---------------|-------------------|-------|---------------|-------------------------|--|---------------------------------------|--|
|             | RBC millions        | Hb. % | MCV cu. $\mu$ | RBC millions      | Hb. % | MCV cu. $\mu$ |                         |  |                                       |  |
| 16          | 2.07                | 33    | 100           | 2.04              | 37    | 109           | 10                      | Cholesterol first, then cholesterol + iron, then hepatex only.                           | Went home undelivered.                | Slight deterioration on cholesterol, poor response to iron + cholesterol and to hepatex, but no further deterioration on hepatex.  |
| 17          | 2.9                 | 50    | 77            | 2.9               | 50    | 84            | 2½                      | Cholesterol only   | Went home undelivered.                | No response to cholesterol.  |
| 18          | 2.4                 | 42    | 88            | 2.68              | 40    | 74            | 5½                      | Cholesterol first, later iron.   | Normal (manual removal of placenta).  | No response to cholesterol.  |
| 19          | 2.7                 | 45    | 94            | 3.4               | 50    | ..            | 9                       | Cholesterol only   | Went home undelivered.                | Admitted for pulmonary tuberculosis, anæmic, pregnant, satisfactory response to treatment. General improvement might account for improvement of blood count.   |
| 20          | 2.64                | 39    | 83            | 3.309             | 38    | ..            | 6                       | Cholesterol only   | Flaring up of pulmonary tuberculosis. | Delivered on the day of admission in normal puerperium. Improvement first, later deterioration of general condition and of blood count too.  |
| 21          | 3.45                | 34    | 64            | 4.3               | 70    | 70            | 5½                      | Cholesterol first, later iron.   | Normal                                | Deterioration on cholesterol. Improvement on iron.   |
| 22          | 0.77                | 15    | 155           | 3.8               | 80    | 83            | 14½                     | Hepatex + cholesterol, then cholesterol only, again hepatex and then cholesterol + iron. | Mild puerperal sepsis.                | Response to hepatex + cholesterol and hepatex alone satisfactory, poor response to cholesterol and cholesterol + iron during pregnancy and septic puerperium, satisfactory response in puerperium after puerperal sepsis had cleared up. |
| 23          | 0.5                 | 12.5  | 156           | 3.5               | 60    | 80            | 9                       | Hepatex first, then cholesterol, later iron + cholesterol.                               | Normal                                | Response to hepatex seen during pregnancy, but better after delivery. Response to cholesterol during normal puerperium satisfactory.   |
| 24          | 0.72                | 17    | 168           | 3.08              | 60    | 109           | 6                       | Hepatex first, later cholesterol.  | Normal                                | Response to hepatex satisfactory. Response to cholesterol during normal puerperium satisfactory.   |
| 25          | 1.08                | 25    | 100           | 1.8               | 35    | 102           | 5                       | Hepatex first, later cholesterol.  | No sepsis                             | Satisfactory response to hepatex. Progress maintained on cholesterol during normal puerperium.   |

TABLE II—*contd.*

| Case number | INITIAL BLOOD COUNT |       |               | FINAL BLOOD COUNT |       |               | Stay in hospital, weeks | Treatment   | Puerperium   | REMARKS   |
|-------------|---------------------|-------|---------------|-------------------|-------|---------------|-------------------------|---|--|---|
|             | RBC millions        | Hb. % | MCV cu. $\mu$ | RBC millions      | Hb. % | MCV cu. $\mu$ |                         |   |  |   |
| 26          | 0.89                | 20    | 140           | 3.6               | 70    | 88            | 9½                      | Hepatex first, later cholesterol.   | Normal   | Satisfactory response to hepatex. Progress maintained during the rest of pregnancy and normal puerperium on cholesterol.  |
| 27          | 0.8                 | 15    | 136           | 2                 | 25    | 133           | 1½                      | Hepatex only  | Mild puerperal sepsis, malaria, bacillary dysentery. | Satisfactory response to hepatex in spite of puerperal sepsis and dysentery (patient later died of intestinal sloughing).   |
| 28          | 0.5                 | 12    | 129           | 2.5               | 55    | 91.5          | 4                       | Hepatex only  | Normal   | Delivered after two days of admission. Satisfactory response to hepatex during normal puerperium. Rate of progress about the same as on cholesterol under similar conditions. |
| 29          | 1.2                 | 19    | 109           | 3.15              | 62    | 97            | 6                       | Hepatex + iron, later liver juice + cholesterol.                                    | Normal   | Response to hepatex and liver juice + cholesterol satisfactory.   |
| 30          | 1.25                | 22    | 91            | 1.55              | 31    | 119           | 8½                      | Hepatex first, then iron, then hepatex again.                                       | Still undelivered.                                   | Slow improvement on hepatex. Deterioration on iron alone in spite of MCV not being raised.  |
| 31          | 1.65                | 20    | 48            | 2.6               | 46    | 93            | 8½                      | Iron only at first, then hepatex + iron, cholesterol added for one week in between. | Still undelivered.                                   | Deterioration on iron alone in spite of low MCV. Slow response to hepatex, better to hepatex + cholesterol and later to hepatex + iron.                                       |
| 32          | 0.8                 | 15    | 91            | 0.5               | 10    | 109           | 1                       | Hepatex only  | No sepsis, malaria.                                  | Deterioration, premature labour and death.  |
| 33          | 0.65                | 15    | 98            | ..                | ..    | ..            | 5/7                     | Hepatex only  | Mild sepsis  | Taken home in a moribund condition three days after delivery.   |
| 34          | 0.55                | 12    | 92            | ..                | ..    | ..            | 3/7                     | Hepatex only  | No sepsis  | Premature labour, heart failure and death.  |
| 35          | 1.5                 | 35    | 99            | ..                | 22    | ..            | 1                       | Hepatex and blood transfusion (three ounces).                                       | No sepsis (diabetes).                                | Premature labour following blood transfusion, heart failure and death.  |
| 36          | 0.7                 | 15    | 116           | ..                | ..    | ..            | 3/7                     | Hepatex + cholesterol.  | Died undelivered.                                    | Coincident diphtheria, heart failure and death.   |
| 37          | 2.55                | 27    | 65.6          | 3.6               | 62    | 99            | 12                      | Iron only   | Normal   | Satisfactory response to iron; iron was stopped once during pregnancy and once during puerperium. Both times there was a setback.   |



TABLE II—contd.

| Case number                         | INITIAL BLOOD COUNT |       |               | FINAL BLOOD COUNT |       |               | Stay in hospital, weeks | Treatment  | Puerperium              | REMARKS   |
|-------------------------------------|---------------------|-------|---------------|-------------------|-------|---------------|-------------------------|--|-------------------------|---|
|                                     | RBC millions        | Hb. % | MCV cu. $\mu$ | RBC millions      | Hb. % | MCV cu. $\mu$ |                         |  |                         |   |
| <i>Puerperal group</i>              |                     |       |               |                   |       |               |                         |  |                         |   |
| 38                                  | 1.2                 | 20    | 109           | 1.1               | 21    | 109           | 3½                      | Cholesterol only   | Mild sepsis, malaria.   | Poor response to cholesterol during puerperium complicated by sepsis and malaria.   |
| 39                                  | 0.8                 | 12    | ..            | ..                | ..    | ..            | 6/7                     | Hepatex only   | Mild puerperal sepsis.  | Deterioration, heart failure and death.   |
| 40                                  | 1.08                | 15    | 76            | ..                | ..    | ..            | 6/7                     | Hepatex only   | Mild puerperal sepsis.  | Deterioration, heart failure and death.   |
| 41                                  | 1.1                 | 17    | 79.3          | 3.25              | 52    | 92            | 8                       | Iron first, then hepatex.                                  | Mild urinary infection. | Poor response to iron in spite of low MCV. Satisfactory response to hepatex.  |
| 42                                  | 1.39                | 21    | 94            | 2.5               | 45    | 100           | 5                       | Hepatex first, then cholesterol.                           | Normal                  | Satisfactory response to hepatex, progress maintained on cholesterol.   |
| 43                                  | 1.5                 | 24    | 108           | 3.6               | 60    | 103           | 11                      | Cholesterol only   | Normal                  | Slow but steady progress on cholesterol.  |
| <i>Non-pregnant group</i>           |                     |       |               |                   |       |               |                         |  |                         |   |
| 44                                  | 1.4                 | 36    | 80            | 4.0               | 67    | 76            | 12                      | Cholesterol and dilute HCl.                                | ..                      | Steady improvement (patient came in with diarrhoea which was controlled with treatment).  |
| 45                                  | 0.6                 | 8     | 110           | 2.5               | 40    | 74            | 14                      | Iron only, then cholesterol + iron, then hepatex + iron.   | ..                      | Poor response to iron only, slow improvement on iron + cholesterol. Better response to hepatex + iron.  |
| 46                                  | 1.1                 | 23    | 99            | 3.65              | 60    | 85            | 8½                      | First cholesterol + iron, then hepatex injections.         | ..                      | Slow response to cholesterol + iron. Response to liver extract much more satisfactory.  |
| 47                                  | 0.84                | 22    | 163           | 4.38              | 75    | 81.1          | 13½                     | First hepatex + iron. Later cholesterol + raw liver juice. | ..                      | A case of subacute combined degeneration and pernicious anaemia. Satisfactory response to liver therapy. Cholesterol did not expedite progress. |
| <i>Microcytic hypochromic group</i> |                     |       |               |                   |       |               |                         |  |                         |   |
| 21                                  | 3.45                | 34    | 64            | 4.3               | 72    | 70            | 6½                      | First cholesterol, then iron.                              | ..                      | Delivered at full term. Response to treatment satisfactory.   |
| 37                                  | 2.55                | 27    | 65.6          | 3.6               | 62    | 99            | 12                      | Iron only  | ..                      | Delivered at full term. Final blood count below normal standards.   |
| 48                                  | 0.9                 | 9     | 84            | 4.2               | 67    | 70            | 14                      | Cholesterol + iron.  | ..                      | Non-pregnant. Response to treatment satisfactory.   |
| 49                                  | 0.9                 | 10    | 73            | 2.5               | 42    | 89            | 4½                      | Iron + hepatex   | ..                      | Non-pregnant. Response satisfactory.  |
| 50                                  | 1.87                | 18    | 89            | 3.7               | 62    | 81            | 6                       | Iron + dilute hydrochloric acid.                           | ..                      | Non-pregnant, achlorhydria. Final blood count below normal standards. No improvement during the last fortnight of patient's stay in hospital.   |

TABLE II—concl'd.

| Case number | INITIAL BLOOD COUNT |       |               | FINAL BLOOD COUNT |       |               | Stay in hospital, weeks | Treatment | Puerperium | REMARKS  |
|-------------|---------------------|-------|---------------|-------------------|-------|---------------|-------------------------|-----------|------------|--|
|             | RBC millions        | Hb. % | MCV cu. $\mu$ | RBC millions      | Hb. % | MCV cu. $\mu$ |                         |           |            |  |
| 51          | 3.8                 | 45    | 74            | 3.4               | 62    | 86            | 2½                      | Iron only | ..         | Non-pregnant. RBC count did not improve, hæmoglobin increase satisfactory. |

*Effect of therapy on blood cholesterol.*—Second and third blood cholesterol estimations were done on some cases to observe the effect of therapy on blood cholesterol. The results of these estimations are given in table III :—

TABLE III

| Case number | CHOLESTEROL PERCENTAGE |             | Interval, weeks | Therapy  | Blood condition                                 |
|-------------|------------------------|-------------|-----------------|--|---|
|             | 1st                    | 2nd and 3rd |                 |  |   |
| 4           | 100                    | 108         | 4.7             | Mostly liver Cholesterol                           | Improved.                                       |
| 5           | < 20                   | 111         | 2               |  | No improvement.                                 |
| 6           | 36.9                   | 66.7        | 16.7            | Liver first, cholesterol + iron later. Cholesterol | Improved.                                       |
| 14          | 66                     | 111         | 2               |  | Improved. Later deteriorated on same treatment. |
| 22          | < 25                   | 66.6        | 2               | Liver mostly. Cholesterol + iron.                  | Improved.                                       |
|             |                        | 20          | 18              |  | Improved.                                       |
| 29          | 12.8                   | 114.2       | 4.7             | Liver + iron, later cholesterol was added.         | Improved.                                       |
| 30          | 15                     | 88.8        | 5.5             | Liver + iron                                       | No improvement.                                 |
| 31          | 28                     | 84.3        | 5               | Liver Cholesterol                                  | Improved.                                       |
| 43          | 56.5                   | 75          | 6/7             |  | Improved.                                       |
|             |                        | 100         | 3               | Iron, cholesterol + iron.                          | Improved.                                       |
| 45          | 39.2                   | 52.6        | 2               |  |   |
| 46          | 22.1                   | 69          | 7.5             | Cholesterol, later liver—12 injections.            | Improved.                                       |
| 48          | 27.5                   | 20          | 13.5            | Cholesterol + iron.                                | Improved.                                       |

### Discussion

*Cholesterol as a substitute for liver therapy.*—A glance at table II shows that cholesterol cannot replace liver in the treatment of macrocytic hyperchromic anæmia in pregnancy. During uncomplicated puerperium the patients did improve on cholesterol therapy, but how

much of the recovery was due to spontaneous remission and how much to the effect of cholesterol, it is difficult to say. Spontaneous recovery, however, seems to be rather a slow process as shown by two cases in the present series (42 and 43) who came to hospital four or five months after delivery in a grossly anæmic condition. They came from fairly well-to-do families and had been having a fairly well-balanced diet.

In the non-pregnant macrocytic cases also response to liver therapy was much more rapid and satisfactory than to cholesterol alone or combined with iron.

An objection might be raised that some of my cases were suffering from coincident diseases, such as malaria, hookworm, diarrhoea, etc., and were not idiopathic cases of pregnancy anæmia. Napier (1940) has discussed this question and has come to the conclusion that exclusion of all cases suffering from coincident diseases does not serve any useful purpose. The disease should be studied against the background of particular standards of health and sanitation in any country. Therefore, I investigated my cases as they came into hospital without any sorting out. But even if a few of such cases were excluded the results of the therapy show clearly that cholesterol cannot replace liver in the treatment of pregnancy anæmia, whether idiopathic or complicated by coincident disease.

### *Cholesterol as an adjuvant to liver therapy.*

—In the present series of cases, eight cases (1, 2, 3, 4, 6, 22, 26 and 36) were given both cholesterol and liver during the first few days of their stay in the hospital. Two out of these eight patients died, giving a mortality rate of 25 per cent. Eleven similarly severe cases (23, 24 and 27 to 35) had liver therapy only. Five out of these eleven died giving a mortality rate of 45.4 per cent. These numbers are too small to come to any definite conclusions but the observations suggest that cholesterol may act as a useful adjuvant to liver therapy. Best and Taylor (1939) state that recent work on cholesterol metabolism has shown it to be closely related to sex hormones, cardiac glucosides, and the so-called 'organizer' of the embryonic tissues, and that it may be the mother substance of these important substances.

We know that large amounts of sex hormones are excreted during pregnancy and the foetus also removes large amounts of cholesterol. This might lead to a relative deficiency of cholesterol for forming cardiac glucosides. Death in pregnancy anæmia is due to myocardial failure and it is conceivable that administration of cholesterol might help the myocardium to tide over the critical period.

*Cholesterol as an adjuvant to iron.*—Some microcytic hypochromic cases were also treated with cholesterol. They failed to improve till iron was introduced. The number of cases treated in this group again was too small to come to definite conclusions, but the results showed the final blood count of the cases who had iron *plus* cholesterol to be higher than in those who had iron only.

Napier and Das Gupta (1937) found the size of the red cells in the Assam coolies to be comparatively smaller, and they failed to raise their hæmoglobin to the usual standards for the urban population. It is possible that this might have been due to cholesterol deficiency. Napier and Majumdar (1938) have shown that iron acts better when combined with improved dietary conditions. Mitra (1939) has found the diet of the Assam coolies to be very poor in fats, especially animal fats. These observations suggest that the important factor in the diet which helps the action of iron may be cholesterol, which is an important constituent of red cell envelope.

*Effect of therapy on blood cholesterol.*—Tables I and III show that there is no constant relationship between the blood cholesterol content and red cell and hæmoglobin concentration of the blood. Of the twelve cases where second and third cholesterol estimations were done two (22 and 48) showed extremely low blood cholesterol figures at the end of the treatment in spite of their blood count having risen to the normal level. In three cases (5, 14 and 30) blood cholesterol had increased though there was no improvement of the anæmia.

In the remaining seven cases both the blood count and blood cholesterol had improved. Six cases out of these seven had been given cholesterol injections at some time or other during the course of the treatment; the seventh case had been treated with liver only.

*Selection of cases for liver therapy.*—There is a school of thought who recommend that therapy in anæmia should be guided by the mean corpuscular volume and liver treatment should be reserved for cases where mean corpuscular volume is high, and cases with normal or low MCV should be treated with iron. My experience has been that patients suffering from pregnancy anæmia, even when the colour index is orthochromic and the MCV is within the normal range, do better on combined liver and iron therapy than on iron alone. I tried a few cases of this type on iron or combined iron and cholesterol therapy. Their blood picture

deteriorated and became definitely macrocytic and hyperchromic (e.g., 12 and 30). They improved when hepatex injections were added to iron therapy. We know that in pregnancy generally there is a mixed deficiency of iron and the specific hæmopoietic substances supplied in liver and marmite. Anæmia caused by iron deficiency is microcytic and hypochromic, whereas anæmia caused by the deficiency of the specific hæmopoietic substance is macrocytic and hyperchromic. If the two deficiencies balance each other the blood picture will be orthochromic with a normal MCV. A blood film under the microscope will show marked anisocytosis macro- and microcytes being more or less equal in numbers. This type of anæmia will naturally not respond to treatment with iron alone.

#### *Summary of conclusions*

1. Cholestérol cannot take the place of liver in the treatment of tropical macrocytic anæmia in pregnancy. In the advanced stages of the disease response to liver therapy may also be poor, but is certainly better than cholesterol.
2. The death rate in the cases in which cholesterol and liver were given was lower than in those in which liver alone was given. Therefore, it is suggested that cholesterol may be usefully combined with liver therapy in the treatment of severe cases of macrocytic anæmia in pregnancy.
3. In normal puerperium cholesterol seems to be effective in hastening recovery, and the response in these cases seems to be as satisfactory as with liver, especially when cholesterol is combined with iron.
4. In the puerperium complicated by sepsis liver treatment is more effective than cholesterol treatment.
5. In tropical macrocytic anæmia in the non-pregnant, cholesterol helps the hæmopoietic action of iron to a certain extent, but even here improvement is much more rapid on liver therapy.
6. Results of treatment in the microcytic hypochromic group suggest that cholesterol helps the hæmopoietic action of iron, but the number of the cases treated was too small to enable one to come to a definite conclusion.
7. Blood cholesterol is very low in all cases of severe anæmia, irrespective of pregnancy.

#### *Acknowledgment*

I am grateful to Dr. Epps, the then professor of medicine at the Lady Hardinge Medical College, for her kind permission to carry out these investigations on the patients admitted in her wards and I thank the rest of the staff in the medical unit for their help and co-operation. My thanks are due to Dr. Soman, the then professor of pathology, for giving me facilities for hæmatological studies and to Dr. Benjamin, assistant to the professor of pathology, for doing some of the blood counts.

(Concluded on opposite page)

# QUINACRINE IN THE ERADICATION OF *GIARDIA LAMBLIA* INFECTION

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THE pathological significance of *Giardia lamblia* infection in human beings is still disputed. Some workers fail to attach any

(Continued from previous page)

I am grateful to Dr. Bhagvat, the lecturer in biochemistry, for giving me facilities for biochemical studies and for carrying out some of the estimations. I am indebted to her for useful criticism and guidance.

In the end I thank all those who offered their blood for normal blood cholesterol estimations.

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importance to this organism and believe that symptoms produced in the human body are not due to this protozoa alone but are perhaps caused by some other concurrent factor or factors. On the other hand, there are quite a large number of workers who definitely maintain that this flagellate does play an important pathogenic rôle and its presence in the gut produces symptoms which deserve the serious attention of the physician. Alvarez, Silverton and Bernardino (1938) are of opinion that the fact that the infection as well as the symptoms disappeared after treatment with atabrin proved beyond doubt the pathogenicity of this flagellate. Chopra, Das Gupta, Sen and Ahmed (1939) concluded that in some cases, at least, particularly in children, this flagellate may produce intestinal disturbance.

Since Galli-Valerio (1937) pointed out the efficacy of atabrin in the treatment of giardial infection, a number of workers have brought forward copious evidence with regard to the beneficial effect of this drug. They are: Martin (1938), Heilmann (1938), Gruneis (1938), Porges (1938), Romano, Rey and Meiller (1938), Bacigalupo (1937, 1938), Konu, Basnuevo, Stolongo and Anido (1938), Cain and Sikorav (1938), Love and Taylor (1940), Mondoul (1939), Chopra, Das Gupta, Sen and Ahmed (1939), Menk and Mohr (1939), DeMuro (1933), Niño (1939), Acosta Silva (1938), Balena (1939), Gruneis and Pilgerstorfer (1939) and Galizzi (1939). Prior to this, however, giardiasis was considered to be a condition which was not easily amenable to treatment, although there are records of successful treatment with neosalvarsan (Lauda, 1934), neosalvarsan and yatren (De Paula and Silva, 1938), spirocid or salvarsan (Breuer, 1938), naphthalene purified by sublimation (Borges, 1931), intramuscular injections of pyretrines (Componovo, 1936), di-hydranol (Thonnard-Neuman, 1931; Mackie, 1931), bismuth salicylate (Zahorsky, 1928), yatren (Luchini and Perez de Nucci, 1927), stovarsol (Pawan, 1926; Basu Mallik, 1926), intramuscular injection of solu-salvarsan (Virnich, 1937) and bismuth sublimate in large doses with other drugs (Enault, 1937). Fredrich (1938) stated that every person harbouring giardia needed an energetic course of treatment and that, since there is no certain cure for the condition, the best results were obtained by intraduodenal introduction of salvarsan and duodenal lavage. Petrowych (1931) emphasized the pathogenicity of giardia and found that the best results were obtained by intravenous injections with neo- and novo-salvarsan with periodical duodenal lavage with 25 per cent magnesium sulphate solution.

Martin (1937) and Tanguy (1937) employed the French equivalent, quinacrine, in the treatment of giardiasis and found that dosages, similar to that given orally for malaria, eradicated the infection. De Muro (1939) has,

however, pointed out that acranil—a hydrochlorate of a new acridinic compound (Bayer)—was even better than atebirin. Grott (1939) stated that whereas atebirin produced a toxic effect in certain cases, this did not result when acranil (previously known as 'Sostol') was used. Vortina (1940) treated cases of giardiasis with acrichine.

In this article, we have recorded a few cases of giardial infection which were successfully treated with quinacrine (May & Baker). The mode of treatment was as follows: 3 tablets of 0.1 gramme of quinacrine per day administered orally for 5 days, the process being repeated after an interval of one week or 5 days. Some patients required a third course of treatment for the complete eradication of the flagellate and the symptoms.

No protozoa, other than *Giardia lamblia*, were encountered in the faecal samples of the cases recorded here. A daily examination of stool samples was carried out from the commencement of treatment and we detected a rapid diminution in the number of organisms eliminated with the excreta.

It is emphasized that the possibility of a giardial infection in cases with vague abdominal pains should always be borne in mind and that the microscopical examination of the stool is of the utmost importance in all such cases.

A brief history of six cases of giardiasis which were treated with quinacrine (May & Baker) is given below:—

**Case 1.**—Hindu, male child. Age 7 years. Vague abdominal pains for past two years; occasional diarrhoea, and often a rise of body temperature up to 103°F. for one or two days; general health poor. Examination of stool showed a large number of giardia cysts. Quinacrine treatment started:  $\frac{1}{2}$  tablet, *i.d.*, for five days. Examination of stool from second day of treatment onwards showed a rapid decrease in the number of cysts. An interval of one week was allowed during which no medicine was administered. Few cysts were seen when the second course was started. At the end of this course, giardia had completely disappeared from the stool. The child has since showed a marked improvement in his general health and has not complained of further abdominal discomfort.

**Case 2.**—Hindu, female. Age 25 years. This was an interesting case. She had undergone an operation for clinical appendicitis and uterine displacement. Afterwards she often complained of abdominal pain which was attributed to the adhesion resulting from the abdominal operation. She gave no history of diarrhoea or dysentery. After a mild purgative, an examination of the stool revealed both vegetative and cystic forms of giardia.

Quinacrine treatment started: 2 gm., *i.d.*, for five days. Second day after treatment—the stool was negative for giardia. After an interval of seven days, a second course was administered. The abdominal pain disappeared altogether and she felt very much better. Subsequent history for past seven months—no abdominal pain or discomfort.

**Case 3.**—Hindu, male child. Age 5 years. Complained of abdominal pain below the umbilicus after meals. At times he felt sick and vomited undigested food. No rise of temperature and no diarrhoea. The

father of the child said that the boy was usually constipated. Examination of the stool showed a fairly large number of giardia cysts.

Two courses of quinacrine effected a complete cure.

**Case 4.**—Christian, female child. Age 10 years. Complained of pain in the abdomen, usually in the afternoon. This would last for two or three days, after which the symptoms would abate for some time.

During one of these attacks she was brought to us and general examination showed nothing unusual. There was no history of diarrhoea or dysentery. An examination of the stool, however, revealed a heavy giardial infection, which quickly responded to treatment with one course of quinacrine. Her stool has since remained negative for giardia and there has been no further complaint of abdominal pain.

**Case 5.**—Hindu, male. Age 25 years. The patient was somewhat neurotic and complained of abdominal pain with a history of diarrhoea and dysentery. He also complained of passing froth and mucus in the stool. He had been treated for amoebic dysentery before he came to us and had had a course of emetine injections. (Presence of amoeba in the stool was, however, not confirmed by microscopical examination before he went through the course of emetine.)

After a mild purgative, an examination of the stool showed a very large number of giardia cysts. Quinacrine was given for five days at the end of which his stool still showed a few giardia cysts. The second course was given after an interval of seven days. At the end of this course, his stool was negative for giardia and the patient felt better. However, a third course was given after an interval of seven days and this caused a marked improvement in the general health of the patient. His abdominal pain has completely disappeared and he has developed a normal appetite.

**Case 6.**—Hindu, male child. Age 10 years. Had been complaining of abdominal pain accompanied by loss of appetite and general debility for the past three years. He was treated by various *vaid*s and *hakims* before he came to us. Examination of his stool showed a very large number of giardia cysts. Quinacrine in the usual doses for one week led to a marked improvement in his general health and the patient complained of no further abdominal discomfort or pain. Three days after treatment the stool was negative for giardia. The boy now looks cheerful and his appetite has returned to normal.

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# FURTHER EXPERIENCE OF THE TREATMENT OF SUPERFICIAL KERATITIS WITH RIBOFLAVIN

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In a recent paper (Aykroyd and Verma, 1942) the occurrence in India of superficial keratitis due to riboflavin deficiency was reported for the first time. The treatment of 13 cases by the injection of riboflavin, with dramatic results, was described. Since the above paper was prepared, a further series of 50 cases has been observed and treated in a similar manner with similar results. While this type of keratitis is probably very common in India, its aetiology is not yet generally recognized by clinicians. A brief account of the successful treatment of a larger number of cases will be of value in confirming the results previously obtained and in drawing the attention of medical practitioners to the condition.

The literature of riboflavin deficiency was reviewed in the earlier paper and a further review is unnecessary here.

## Description of cases

The present series of cases, like the previous one, was observed and treated in the Government Ophthalmic Hospital, Madras. The characteristic signs and symptoms were described in the earlier paper. These include photophobia, itching, burning, pain and lacrymation, usually involving both eyes. Opaque dots and streaks are to be seen in the superficial layers of the cornea, with superficial ulcers in some cases. In the second series of 50 cases, vascularization of the cornea was present in about 60 per cent. The pannus was always superficial and confined to the periphery of the cornea. Squamous blepharitis and phlyctenular conjunctivitis were observed in 2 and 3 cases respectively.

Angular stomatitis and fissured tongue were present in 85 per cent. In the cases not showing a fissured tongue, the tongue appeared smooth, with flattened papillae. Nearly all cases complained of a burning sensation in the mouth when food was taken. In one case the lips were denuded of epithelium and were raw, fissured and tender. This case showed squamous blepharitis without keratitis.

In 95 per cent of the male cases there was dryness, scaliness and itching of the skin of the scrotum. The scrotal lesions were in general not very pronounced.

## Treatment

This consisted of the oral or parenteral administration of pure riboflavin. All cases responded rapidly to treatment with riboflavin;

within 24 hours there was subjective improvement and all signs and symptoms usually disappeared within 3 to 10 days, depending on the severity of the case. The vision improved owing to the disappearance of superficial opacities. The vessels in the cornea 'closed down' and the angular conjunctivitis disappeared *pari passu* with the other signs. Coincident blepharitis also responded to the treatment. It would be interesting to observe the effect of riboflavin on chronic intractable cases of squamous blepharitis uncomplicated by keratitis.

The usual parenteral dose was 2 milligrammes given daily until the eye condition was cured. Relief also followed oral administration, but larger daily doses—4 to 6 mg.—were required and the curative effect appeared to be in general less rapid. The injection of the vitamin appears to be the treatment of choice. Proprietary preparations of pure riboflavin could not be obtained for the investigation. Solutions of riboflavin for oral and parenteral administration were made up in the Nutrition Research Laboratories.

In the case referred to above, showing severe blepharitis but no keratitis, rapid healing of the lesions of the lips was observed. This is a point of interest, because American workers (Sebrell and Butler, 1938, 1939) have reported a 'reddened, denuded condition of the lips' as a characteristic sign in ariboflavinosis. For some unexplained reason, this sign was rarely present in the cases of ariboflavinosis observed in Madras. The other oral lesions responded to treatment, though less rapidly than the eye lesions.

Recurrence within a few weeks was observed in a proportion of cases—the liability to recurrence was commented on in the previous paper. Little further information about susceptibility to recurrence could however be obtained in the present investigation, owing to the fact that it was carried out during a period in which Madras City was being steadily evacuated and the number of out-patients attending the Ophthalmic Hospital was falling day by day.

Riboflavin treatment was tried in 3 cases of trachomatous pannus. The results were doubtful. A little subjective relief was obtained but the pannus persisted. The cornea appeared to regain lustre and vision improved owing to the disappearance of some opacities. Further investigation of the possibility of obtaining some relief of trachoma by riboflavin treatment is necessary. It is possible that the administration of riboflavin will prove a valuable adjuvant to other forms of treatment in various eye diseases.

The following 8 cases, 3 male and 5 female, may be taken as characteristic of the group:—

Case 1.—Female, aged 30 years. Complained of photophobia, burning, watering and itching in both eyes for one month. The corneas showed superficial opacities and angular conjunctivitis was present. A



conjunctival smear revealed Morax-Axenfeld bacilli in plenty. The patient had marked angular stomatitis and fissured tongue. Four mgm. of riboflavin were given intramuscularly daily for five days. All ophthalmic signs and symptoms disappeared and the smear became negative. The mouth condition showed improvement.

Case 2.—Female, aged 32 years. Complained of photophobia, burning, watering and dullness of vision for two months. She showed superficial keratitis and superficial opacities in the centre of the cornea of both eyes. Vision was R 6/12, L 6/60. She had angular stomatitis and fissured tongue. Riboflavin was given partly by injection and partly by oral doses, the total amount given being 20 mg. in eight days. All the irritative symptoms disappeared. Vision after the treatment was R 6/9, L 6/24. The opacities had not completely vanished.

Case 3.—Female, aged 30 years. Complained of photophobia, burning, itching and lacrymation. A thick exudate was present at the angles of both eyes. The patient stated that the condition had persisted for four months. There was superficial keratitis and angular conjunctivitis. Angular stomatitis and fissured tongue were also present. Conjunctival smears showed abundant Morax-Axenfeld bacilli. The patient had been treated in the hospital for three weeks with the usual routine treatment without relief. Riboflavin was given orally in 5 mg. doses for seven days, without any local treatment. All the symptoms and signs disappeared and the smear became negative.

Case 4.—Female, aged 18 years. Complained of photophobia, burning, lacrymation and dullness of vision for three months. There was superficial keratitis, more pronounced in the right cornea. Vision was R 6/24, L 6/36. Angular stomatitis and fissured tongue were present. She had tender calves and could not walk. The knee jerks were absent. Riboflavin was given for four days in 2 mg. doses, intramuscularly. All the eye symptoms vanished and the vision became R 6/18, L 6/24. There was marked improvement in the oral condition. No change occurred in the legs. She was then given yeast 15 grammes *i.i.d.*, for four days, with improvement in the leg condition.

Case 5.—Female, aged 15 years. Complained of itching of the lid margins for three months and a burning sensation in the mouth. The lid showed squamous blepharitis and there were seborrhœic scales on the eye-brows. There was well-marked denudation of the lips and fissured tongue. No keratitis was present. The patient was given injections of riboflavin, 2 mg. daily, for 11 days. The itching of the lid subsided, and the squamous blepharitis disappeared. The lips were healed and the patient ceased to complain of burning in the mouth.

Case 6.—Male, aged 30 years. Came with complaints of photophobia, burning, itching and dullness of vision. The patient showed superficial keratitis in both eyes. There were a few small central opacities. Angular stomatitis was present. The tongue was smooth and without fissures. Vision was R 6/6, L 6/24, and there was no improvement with glasses. Riboflavin, 2 mg. intramuscularly for five days, was given. All the irritative symptoms disappeared and the vision became R 6/6, L 6/6.

Case 7.—Male, aged 17 years. Complained of photophobia, watering and burning of both eyes of two months' duration. Superficial keratitis was present in both eyes. Angular stomatitis with fissured tongue was present. The scrotum was rough, dry, scaly and itchy. The vision was R 6/18, L 6/24. Riboflavin was given for 13 days in 4 mg. oral doses. All the signs and symptoms were relieved and vision became R 6/6, L 6/9.

Case 8.—Male, aged 10 years. Had watering, photophobia, and burning sensation in the eyes for one month. Showed phlyctenular conjunctivitis along with superficial keratitis in both eyes. Riboflavin was given orally and parenterally, the total amount administered being 18 mg. The phlyctenular conjunctivitis and keratitis disappeared in nine days.

(Concluded at foot of next column)

## INDISCRIMINATE DRUG THERAPY

### A PLEA FOR WAR-TIME DRUG ECONOMY

By ANTHONY CAPLAN, M.D. (Lond.),  
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'As the war progresses, the need for strict economy in the use of drugs increases. Sources of a number of crude drugs and of the raw materials for the manufacture of synthetics are now closed to this country, and this, together with the necessity of conserving foreign exchange and avoiding the waste of shipping space by the importation of non-essential drugs and chemicals, renders the problem of finding adequate alternatives pressing'.—Extract from preface to the *Extra Pharmacopœia*, volume 1, 1941.

Drug economy is surely as necessary to the war effort in India as it is in England. A marked increase in the local manufacture of drugs since war began has certainly helped to relieve the drug problem in India, but many raw materials are scarce and valuable shipping space is still being taken up with certain essential drugs which have to be imported from abroad. Quite apart from drug economy being necessary as a war-time measure, sound arguments can be put forward to show that a reduction in the consumption of drugs would be beneficial to a public made drug-conscious by extensive advertising campaigns. One thing is certain, the patient would not suffer; on the contrary a greater quantity of essential drugs would be available to those who really need them.

Recent notable advances in therapeutics may well be the forerunner of a new era in medicine when therapeutics will be established on a scientific basis. The attainment of this ideal will, however, be deferred so long as the abuse of newly introduced therapeutic substances continues. That such an abuse exists is an every-day experience; that it is far too common

(Continued from previous column)

### Summary

Fifty cases of superficial keratitis have been treated by the oral and parenteral administration of riboflavin. Rapid relief of signs and symptoms was obtained.

### Acknowledgment

The facilities for the investigation provided by the Superintendent and staff of the Government Ophthalmic Hospital, Madras, are gratefully acknowledged.

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there can be little doubt. Indeed, the worst examples of indiscriminate therapy are connected with recent advances in therapeutics, *e.g.*, the treatment of anæmias, avitaminoses, endocrine dysfunctions, and chemotherapy.

This note is written with the object of drawing attention to the more blatant examples of indiscriminate prescription of drugs which have come to the writer's notice during recent months.

### *The treatment of the anæmias*

Anæmia is extremely common in this country, and in my experience the microcytic type, associated with an iron deficiency combined with an excessive blood loss, is very much more common than the macrocytic type associated with a deficiency of Castle's intrinsic and extrinsic factors, although it is fully realized that anæmias of multiple origin are by no means rare. It seems hardly necessary to point out that the treatment of anæmia is hopeless without an expert opinion on the blood picture; yet how many cases are there of so-called anæmia, at the present time, diagnosed by a cursory glance at the patient, being treated with expensive parenteral liver preparations? And how many more cases are there of a pure iron-deficiency anæmia being treated with 'injections of liver'? And how frequently are 'liver injections' given as a tonic? Accurate replies to the above questions would emphasize the urgent need of moderation in parenteral liver therapy.

### *Illustrative case.—*

Female, *æt.* 50, suffering from an anxiety state and microcytic anæmia. Hb. 52 per cent, red cells 3,900,000, C.I. 0.66. She complained of 'neuritis all over' of many years' duration, the relapses always coinciding with periods of maladjustment to her environment. The anæmia was greatly improved with a standard iron preparation, but she decided to seek expert advice for her 'neuritis' and returned with the following substances. An oral liver preparation, a parenteral liver preparation, a parenteral vitamin-B preparation, nicotinic acid, a 'liver stimulating' medicine and a sedative. Approximate cost Rs. 100. An iron preparation was conspicuous by its absence.

### *Vitamins and tonics*

It is not the intention of the writer to suggest that an abundance of vitamins is obtained by all and sundry. On the contrary, a more liberal distribution of vitamin preparations in the right quarters is an urgent necessity if the major and minor degrees of avitaminoses so commonly seen in practice are to be prevented. It is contended that expensive vitamin preparations are frequently issued as a 'tonic' to people well able to obtain a sufficiency of vitamins in a well-balanced diet, and in whom no sign of vitamin deficiency can be detected. In addition certain vitamins are given as a specific for conditions not even remotely connected with an avitaminosis.

Not very many years ago the routine 'tonic' was a gentian and rhubarb mixture with a dash of bromide, and it is questionable whether

this was less effective in 'toning up the system' than many of its modern expensive counterparts. The question may legitimately be raised as to what is the effective therapeutic agent in a bottle of medicine given as a 'tonic'. Is it its colour (of the medicine and bottle), its taste, its price, its country of origin (especially before the present war), or its pharmacologically active contents? Or is it the doctor's re-assurances—aptly described as 'tincture of kindness'—that go with it? I personally believe the latter to be the most important factor, for if the patient can be convinced that his 'system' is about to be 'toned up', he will certainly feel 'toned up' at his next visit—irrespective of the contents of the bottle. Nowadays the doctor's 'tincture of kindness' is hardly necessary in initiating this simple psychotherapeutic cure; vested interests combined with extensive advertising campaigns have ousted the medical man as an expert on 'tonics'. Surely this aspect of therapeutics is worthy of further research, for if the contents of the bottle are of secondary importance why waste expensive—and otherwise useful—drugs?

In this respect the attitude of the patient is not an unimportant factor. There is little doubt that many patients would consider they were not getting their money's worth if they returned from the doctor's consulting room without at least a bottle of medicine. A course of injections would of course be much more satisfactory—especially amongst certain types of women who are always in need of fresh material to strengthen their case at the not uncommon competitive discussions on their ailments—real and imaginary. It is surely the duty of the medical profession to discourage this bottle of medicine habit and to enlighten the public on the greater importance of preventive medicine. For example, there can be no justification for the prescribing of 'tonics' to previously healthy patients convalescent from an acute febrile illness such as lobar pneumonia, or after an operation such as appendicectomy, when all the patient needs is adequate rest, sleep and an abundance of good food.

The medical profession itself is unfortunately not completely immune from the influences of fashion and advertisements. It seems fashionable at the present time to use parenteral vitamin-B preparations (or is vitamin E now taking its place?) for any disease connected with the spinal cord or peripheral nerves. None will deny the extreme value of this vitamin in beri-beri and certain forms of peripheral neuritis, but it is difficult to appreciate the rationale of the exhibition of the vitamin in 'neuritis', syphilitic myelitis and acute anterior poliomyelitis, examples of which the writer has recently seen.

The following experience may be of interest in demonstrating the care to be taken in assessing the value of a therapeutic substance and as an example of the possibilities which exist in

saving drugs. A certain plant had gained a local reputation in the cure of 'sore tongue', and it was decided to give it a trial in cases of angular stomatitis and glossitis. Six cases were treated with recommended quantities of the leaf *plus* a light diet and the results were uniformly good, the mouth and tongue lesions disappearing within 7 days. A specimen of the leaf was sent to Dr. W. R. Aykroyd at the Nutrition Research Laboratories, Coonoor, who kindly identified it as *Sesbania grandiflora*. He suggested that 1½ pints of milk included in the light diet would in itself produce an improvement in the condition. A further series of cases were then treated with the sesbania leaves *plus* an ordinary hospital diet: *i.e.*, mutton 6 oz., rice 12 oz., vegetables 4 oz., bread 4 oz., coffee 1 pint (no milk), and the results were equally satisfactory. It was then decided to treat a control series of cases with the ordinary hospital diet alone, and it was noted that the condition was cured in approximately the same time. All cases of angular stomatitis or glossitis due to a vitamin-B<sub>2</sub> deficiency are now treated with ordinary hospital full diet which apparently contains a sufficiency of vitamin B<sub>2</sub> to cure the condition. Previously marmite had been used, which means that a considerable saving in a potent and scarce remedy has accidentally been effected.

### Endocrine preparations

Endocrine substitution therapy has made tremendous strides in recent years and many conditions in which a true endocrine deficiency exists can now be greatly relieved or even cured. But endocrine therapy has its limitations and may even be dangerous if used indiscriminately, for it must be remembered that, firstly, endocrine products—natural or synthetic—are potent substances having a specific physiological effect, and, secondly, the sexual hormones are allied in chemical structure to carcinogenic substances. Accurate diagnosis and some familiarity with the dose of these preparations is therefore highly desirable. Without any pretence to being a gynaecologist the writer considers that the following cases illustrate the misuse of endocrine preparations:—

*Case 1.*—Multipara, *æt.* 25, two children *æt.* 2 and 4. Complained of indefinite lower abdominal pain since birth of second child. Nothing abnormal found on examination apart from slight tenderness and thickening in the left fornix probably secondary to cervical tear. Laparotomy some months later by a surgeon revealed a long and tortuous appendix, and a few cysts in both ovaries. An appendicectomy was performed. The post-operative treatment included a course of follicular hormone which was continued for three months.

*Case 2.*—Primipara, *æt.* 20, ten weeks' amenorrhœa. Morning sickness for past six weeks. Vomiting never severe and patient in good health. Had been receiving a course of luteal hormone for the past four weeks with no improvement.

*Case 3.*—Multipara, *æt.* 30, two children *æt.* 3 and 6. Three months' amenorrhœa. Sudden onset of bleeding from vagina with passage of 'large clot'. Patient had been treated during the past week with

luteal hormone and wheat-germ oil. Exploration of uterus revealed retained products of conception; fetus was almost certainly passed in the 'large clot'.

### Sulphonamide group

The introduction of the sulphonamide group of drugs has proved to be the greatest therapeutic advance probably of all time, but it is not a panacea for all the ills of man—and beast. The value of this group of drugs in certain specific diseases is firmly established, and further research with new products indicates that many more diseases may be combated with these valuable drugs. A controlled experiment on the value of the sulphonamides in almost any bacterial infection is legitimate and is to be encouraged, but the indiscriminate use of the drug—often in inadequate dosage—in any febrile state without an attempt at an accurate diagnosis is, at the present time, wasteful and to be discouraged. Instances of the waste of sulphonamides—too numerous to mention—are almost daily occurrences, and they emphasize the fact that care and accuracy in diagnosis is the doctor's first duty to his patients.

### Quinine

It should hardly be necessary to point out the following important facts: Firstly, malaria is extremely common in this country, secondly, quinine is a specific for malaria, and, thirdly, the major supply of quinine from the Dutch East Indies has been completely cut off. By simple deduction the urgent need for economy of quinine is obvious. Economy can be effected by limiting the use of this essential drug to *bona-fide* cases of malaria, and ceasing forthwith the issue of quinine preparations for conditions such as 'influenza' and feverish colds in which, as far as is known, there is no scientific evidence to show that the drug is of the slightest value. Ideally quinine should be withheld from all suspected cases—excepting in cerebral malaria and other fulminating types—until the diagnosis is confirmed by a blood smear. The ideal unfortunately is not practicable in all parts of the country, but that greater care is needed in the clinical diagnosis of malaria is well illustrated in the following comparison of statistics. Hospitals A and B dealt with an equal number of patients from the same localities. Hospital A performed about 80 blood examinations every year and B about 5,000. During the same year, hospital A reported over 11,000 cases of malaria and hospital B under 800.

### Polypharmacy

The lengthy prescriptions used by our fathers and grandfathers have almost completely disappeared, and now is as good a time as any to ask ourselves whether our own prescriptions could be cut down without therapeutic loss to the patient. Are all the drugs included in our common 'fever' mixture, cough mixture, stomachics and tonics therapeutically effective,

(Concluded on opposite page)

## THE GALL-BLADDER AND ITS VEINS

By F. V. STONHAM

MAJOR, I.M.S.

ANATOMY textbooks describe and depict a cystic vein corresponding to the cystic artery terminating in the right branch of portal vein. Works on operative surgery usually do not refer to the cystic vein at all, but many surgeons, I believe, regard this vessel as non-existent, and consider that the venous blood of the gall-bladder always passes directly to the liver through anastomoses between small venous channels of the two organs. In performing the classical type of operation cholecystectomy it is customary first to dissect out and identify the biliary ducts, and then the cystic artery and its parent trunk as well. It does not appear usual to bother about any venous channels, though it is usually considered to be preferable to commence the dissection of the gall-bladder from the region of the ducts to avoid obscuring the field by the blood which oozes from the denuded area of the liver. The disadvantages of commencing the dissection from the fundus seem to have been somewhat exaggerated. However, with the exception of Thorek's technique (1938) which has recently been strongly endorsed by Bailey and Love (1939) in which the gall-bladder is partly removed and the remainder coagulated by diathermy and sutured, and in some cases where the organ is removed by the clamp method advocated by Tucker (1938), it is almost universal practice to insert a drainage tube down to the site of the operation. This is done partly to allow exit of the blood and bile which exudes from the raw area of the liver, and also bile from any accessory hepatic duct which may have been overlooked and divided, and partly because the comparative frequency of post-operative hæmorrhage following cholecystectomy has earned for this operation some notoriety. This is perhaps somewhat undeserved since, in my experience, except in difficult cases where operative trauma makes drainage imperative nothing much seems to come out of the tube. However, on account of the great frequency of anatomical variations which may be encountered in this region, which have been

(Continued from previous page)

and would the patient suffer if certain ingredients were omitted or reduced in quantity? Further information on these points would help us to decide as to what necessary drugs are real necessities.

*Acknowledgments*

I have much pleasure in acknowledging my thanks to the chief medical officer, Kolar Gold Field Hospital, Dr. W. B. Roantree, and Messrs. John Taylor & Sons for permission to use the case reports, and to Dr. Aykroyd for his report on the sesbania leaf and valuable criticisms.

so ably described by Flint (1923) and since the technical difficulties in this operation may at times be very formidable, drainage is some safeguard against the consequences of closure of the abdomen with a divided unrecognized accessory artery or duct which has not been secured.

The likelihood of venous bleeding, so far as I am aware, is seldom considered. In *post-mortem* examinations, especially in cases of asphyxia due to hanging or opium poisoning, I have not infrequently observed a cystic vein of large size, which would be quite capable of causing severe or dangerous bleeding. It is possible that in some cases of hæmorrhage during or following operations on the biliary tract the origin has not been arterial, but venous. Compression of the gastro-hepatic omentum would be expected to control bleeding from veins connected with the portal system as well as branches of the hepatic artery because in both cases the compression would be proximal. The above-mentioned observation has prompted me to carry out fifty dissections on fresh subjects most of which were young and healthy, and death had been due to violence. Venous drainage of the gall-bladder was found to be of the following types:—

*Type I: the commonest* (figure 1).—Direct anastomosis occurs between the small venules of the gall-bladder and the liver. These can be traced on histological study of a section passing at right angles through the area where the gall-bladder is attached to the inferior surface of the

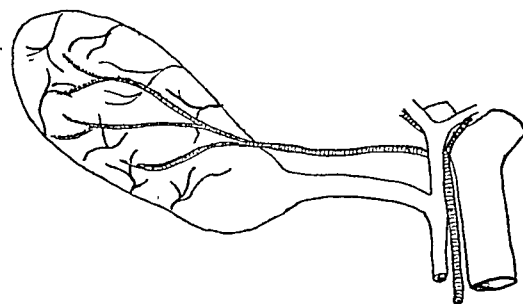


Fig. 1.—Type I. Small venules anastomose with vessels in the liver.

liver by connective tissue. In addition, small straight veins are formed by the anastomosis of venules on the inferior surface of the gall-bladder, which again break up into small branches before they enter the liver. These vessels run roughly at right angles to the long axis of the gall-bladder. They are small and not always apparent to the naked eye unless congested.

*Type II: nine cases* (figures 2, 4 and 5).—A single venous trunk of comparatively large size corresponding to the cystic artery joins the right branch of the portal vein, as in anatomy textbooks, or terminates elsewhere.

*Type III: two cases* (figure 3).—The cystic veins are as in type II but are multiple.

*Type IV : two cases.*—This is a combination of types I and II. Though the gall-bladder varies considerably in position in relation to the

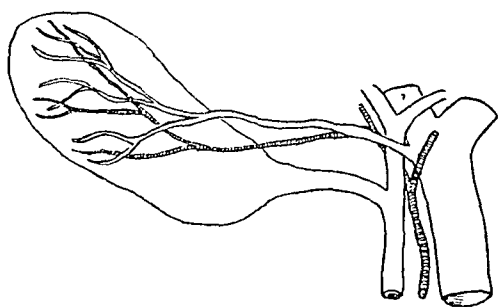


Fig. 2.—Type II. Cystic vein joins the right branch of the portal vein passing in front of the hepatic duct.

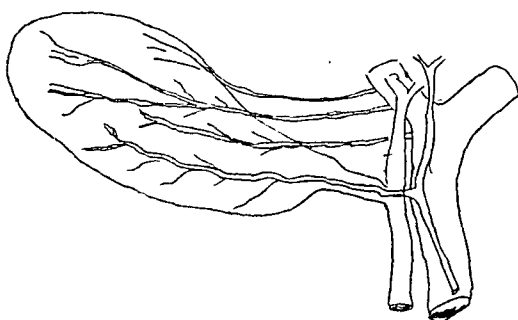


Fig. 3.—Four cystic veins (arteries have been omitted from diagram for clearness). Three join the portal vein and one passes in front of the ducts and ends in a right gastric vein which passes direct to the liver.

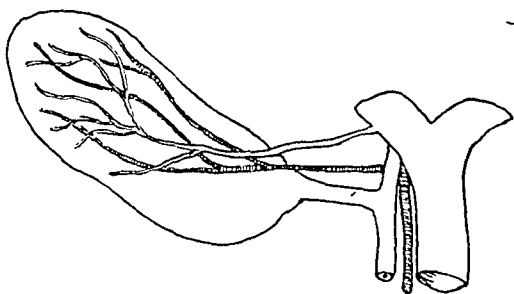


Fig. 4.—Portal vein enters the liver in front of the ducts and arteries.

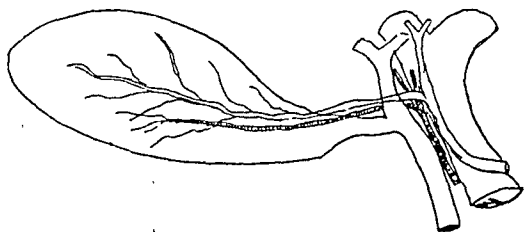


Fig. 5.—Single cystic vein joins an abnormal right gastric (coronary) vein.

vertebræ and in its distance from the midline as seen in radiographs, and while the ducts and vessels very commonly exhibit anatomical

anomalies, the healthy gall-bladder is remarkably constant in shape, size and in its relation to other viscera.

Cases of congenital absence of this organ are rare. Kennon (1933) has described a case of double gall-bladder and cystic ducts. The principal variations that are encountered are in connection with its relation to the liver and to the visceral peritoneum. In the series under discussion all the gall-bladders appeared healthy except one, and only one contained stones and this occurred in a young female, and the stones consisted of a few hard white calcium stones and there was no macroscopic evidence of previous inflammatory mischief. I am aware that the gall-bladder is sometimes entirely buried in the substance of the liver but I have not yet encountered a case either at operation or dissection. Sometimes the viscus is suspended from the liver by a species of mesentery and these cases are eminently suited to removal by Tucker's (1938) simple and rapid operation. Murray (1933) has described a case of torsion in a gall-bladder which was attached only by a pedicle consisting of the cystic duct and the blood vessels and he found reference to only two such cases in the literature. It is, however, extremely common to find the gall-bladder enclosed in a peritoneal fold continuous with the gastro-hepatic omentum, which unites the under surface of the liver to the transverse mesocolon and the transverse colon itself. This is referred to as the cholecystico-duodeno-colic ligament, which is probably better named by the less accurate but briefer term cystico-colic 'ligament'. This 'normal' structure is very apt to be regarded as an 'adhesion' due to previous inflammation. In one case I found that this structure had drawn the transverse mesocolon upwards forming a deep hollow in its under surface and the branches of the colic vessels arched upwards and passed in close relation to the caudal aspect of the gall-bladder before they reached the bowel. In no case were the vessels of the gall-bladder found to anastomose with the colic vessels. Such a union if it occurred would almost certainly be of pathological consequence. Oozing from this site not infrequently occurs at operation when inflammatory adhesions are separated. In all cases where a cystic vein of type II or III was present the gall-bladder was either very loosely attached to the liver, or else it lay, often loosely invested, in a cystico-colic ligament. Apparently it is the closeness of this attachment to the liver which determines the manner of the venous return.

The gall-bladder, liver, and part of the pancreas are developed from the foregut from a diverticulum which passes into the septum transversum. It at once bifurcates into pancreatic and hepatic elements.

That part which is destined to form the liver and gall-bladder again bifurcates, and presumably, to begin with, each has its own independent

blood supply. Subsequently, when the gall-bladder becomes firmly united to the liver, anastomosis between the venous systems of the two organs results in disappearance of the cystic vein. In cases where this does not occur, or its occurrence is hampered after rotation of the gut by abnormal coalescence of the dorsal part of the free edge of the ventral mesogastrium with the transverse colon and its mesentery, the cystic vein persists.

The cystic vein usually passes anterior to the hepatic duct and arteries and joins either the right branch of the portal vein, the main trunk of the portal, or terminates in the coronary vein. It is pointed out that the last vein, not uncommonly, does not end in the portal vein, but follows the course of either the right, or, as in one case, the left gastric artery; and passes up in front of the portal vein and enters liver independently (figure 5). This was seen in four cases. In one case the portal vein twisted spirally round the left side of the arteries and ducts and then bifurcated and entered the liver as an anterior relation, the right branch receiving the cystic vein (figure 4). The surgical importance of such an abnormality is obvious. In another case a well-defined cystic vein accompanied the artery but terminated in a number of small branches which became lost in the capillary plexus of the gastro-hepatic omentum.

A well-developed cystic vein if engorged may be almost equal in calibre to that of a normal common duct, though usually it is not a large vessel. Diagrams in surgical textbooks are often misleading because the ducts, arteries and the portal vein are frequently depicted as though they were each of about equal size. The hepatic artery and its branches are much smaller than usually drawn and are comparatively thin walled. Though easy enough to recognize in dissecting room subjects, in the fresh cadaver they are remarkably like veins when empty and collapsed, and often require careful tracing to their origin to establish their identity beyond doubt. The portal vein is a much larger vessel than usually shown and is as thick as the average fountain pen or thicker. It more commonly passes behind and definitely to the left of the ducts and hepatic artery (except near its origin) than directly behind them as one is usually informed by works on surgical anatomy.

#### Summary

(1) The results of fifty dissections to investigate the venous return of the gall-bladder have been described.

(2) In at least eighteen per cent of bodies a well-marked cystic vein corresponding to the cystic artery was found. (Injection methods were not used and I admit the possibility that in some cases a small cystic vein may have been overlooked.)

(Concluded at foot of next column)

## A WATER EMULSION OF PYRETHRUM EXTRACT FOR SPRAY-KILLING ADULT MOSQUITOES\*

By PAUL F. RUSSELL  
FRED W. KNIPE

and

T. RAMACHANDRA RAO

### Introduction

THE results of Ross (1936), De Meillon (1936), Covell *et al.* (1938), Russell and Knipe (1939, 1940, 1941), and Russell *et al.* (1942) leave no doubt that wherever the mosquito vector of malaria spends its daytime hours inside houses, cowsheds, or outbuildings, routine spray-killing with pyrethrum sprays will effectively interrupt the transmission of malaria. This measure is based on the principle that, if the resting places of the vectors are effectively sprayed at suitable intervals, no female anopheline will live long enough to allow sporozoites to come to maturity. Transmission by *A. culicifacies* was effectively stopped by adopting a weekly spraying interval, in certain villages where it was tried experimentally in Pattukottai Taluk (see Russell *et al.*, 1942).

Pyrethrins, the active toxic principles of pyrethrum, are extremely lethal to mosquitoes, since they are absorbed through the cuticle and destroy nerve tissue.

In spray-killing for malaria control, the usual practice has been to dilute pyrethrum extracts with kerosene. This paper reports the successful use of water as a diluent, with considerable lowering of costs.

### Preparation of spray

The spray reported herewith was a water emulsion of a concentrated kerosene extract of

\*These studies were made under the auspices and with the support of the International Health Division of the Rockefeller Foundation, co-operating with the Madras Health Department, and the Pasteur Institute of Southern India. The authors are indebted to N. R. Sitapathy, assistant engineer, and T. S. Rama Rao, technical assistant, for their collaboration.

(Continued from previous column)

(3) Variations in the peritoneal investment of the gall-bladder have been described, and the likelihood of this having influenced, the arrangement of its venous return has been indicated.

(4) The cystic vein is potentially of surgical importance.

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Indian grown pyrethrum\*, and was prepared as follows :—

### I. Stock extract

1. Twenty pounds of dried chopped pyrethrum flowers were soaked with 5 gallons of water-white kerosene in an air-tight container for 24 hours, and the resultant liquor decanted.
2. The flower residue was again soaked with 5 gallons of water-white kerosene for another 24 hours, and the resultant liquor decanted.
3. The flower residue was then placed in a long narrow tube, with a sieved funnel at the bottom. Then another 2 gallons of kerosene was allowed to drip—drop by drop—through the residue for about 12 hours. The remaining residue was pressed for the last obtainable drops of liquor.
4. All three liquors were mixed together and stored for future use in dark-coloured, air-tight containers. This was the stock extract.

Approximately 10 gallons of extract were obtained from 20 lb. of flowers and 12 gallons of kerosene. Nearly two gallons of kerosene were lost, due to absorption by the flowers. A more efficient press would have saved some of this loss.

### II. Spray emulsion

Emulsions were prepared from stock extract in two dilutions as follows :—

|   |    |    |             |
|---|----|----|-------------|
| A. Stock extract                                  | .. | .. | 1 gallon    |
| Water   | .. | .. | 7 gallons   |
| Emulsifier (sodium lauryl sulphate or 'Gardinol') | .. | .. | 184 grammes |
| B. Stock extract                                  | .. | .. | 1 gallon    |
| Water   | .. | .. | 3 gallons   |
| Emulsifier (sodium lauryl sulphate or 'Gardinol') | .. | .. | 92 grammes  |

The water must be clean and should be filtered through thick cloth before being used. It is preferable to use soft water, but when sodium lauryl sulphate is added, even hard water will make a good emulsion.

The emulsifier, sodium lauryl sulphate, known under the trade name 'Gardinol', was used at the rate of 23 grammes per gallon of emulsion. This quantity was arrived at after experiments which determined the amount required to keep the emulsion in good suspension for the necessary time. Smaller quantities allow quick separation of extract and water. (See also Ginsburg, 1935.)

### Physical properties

Since the emulsion is mainly water, the droplets discharged by the nozzle of a spray-gun are a little heavier than in the case of kerosene sprays, and therefore do not rise so well as the latter. Regardless of this fact, the spray is effective. In fact, on many occasions it has been seen to penetrate upwards through thatched-roof crevices, similarly to kerosene sprays.

\* A water emulsion prepared from a normal dilution of Pyroicide-20 was equally effective. The cost was greater because of the higher price of Pyroicide-20.

### Toxic properties

During several trials conducted in a special insecticide testing chamber, the emulsion gave good results. Tests were made simultaneously with other insecticides. The toxicity was approximately as good as that of either a normal kerosene dilution of Pyroicide-20 (19 to 1), or of a kerosene diluted extract of Indian grown pyrethrum. In direct hits, even in extremely small dosage, the kill was always one hundred per cent. Likewise, in cages kept on the floor of the testing chamber, the kill was usually one hundred per cent. In one series of nine tests it was 99.8 per cent. Even when cages were kept at the roof of the chamber, with the spray directed downwards and away from them, the kill averaged 60 per cent. With free, uncaged mosquitoes in the testing chamber, the kill averaged over 90 per cent. These facts indicate that the toxicity of the emulsion was high. The slightly lower figure for roof cages, when the spray was directed downwards, can be explained as due to the nature of the droplets which are heavier than in kerosene diluted sprays.

Both emulsions, A and B (see above), gave approximately equal results in the testing chamber.

### Field trials

Both emulsions were given extensive field trials in two large villages (Tamarankottai and Sendakkottai) of Pattukkottai Taluk during the malaria season of 1941 (July to November). In both villages spray-killing with these emulsions appeared to interrupt malaria transmission effectively, bringing about a notable reduction in spleen rates. In the village where the stronger emulsion was used the spleen rate dropped from 70 per cent in 1940 to 31 per cent in the malaria season of 1941. Where the weaker emulsion was used, the rate fell from 48 per cent in 1940 to 16 per cent in 1941. In unsprayed villages used as experimental controls, there were no reductions in spleen rates in 1941. Detailed data are being published (Russell *et al.*, 1942).

### Costs

The prices of the materials used in our spray-killing experiments were as follows :—

|                        |    |    | Rs. | As. | P.            |
|------------------------|----|----|-----|-----|---------------|
| Kerosene               | .. | .. | 0   | 14  | 3 per gallon* |
| Pyrethrum flowers      | .. | .. | 1   | 0   | 0 „ pound     |
| Sodium lauryl sulphate | .. | .. | 2   | 1   | 0 „ „         |
| Pyroicide-20           | .. | .. | 45  | 0   | 0 „ gallon    |

\* An Indian rupee consists of 16 annas, each anna of 12 pies. At current exchange, a rupee is worth approximately U.S. \$0.30 or £0.16.

On this basis the costs of the sprays used were as follows :—

|   | Per gallon<br>of mixture<br>Rs. As. P. |
|---|--|
| Pyroicide-20 (1 : 19 mixture with kerosene)   | 3 1 7                                  |
| Indian grown pyrethrum extract in kerosene<br>(1 gallon to 1 pound, further diluted with<br>1 : 1 kerosene) .. .. . | 1 7 10                                 |
| Water emulsion of Indian pyrethrum extract<br>(formula B) .. .. .   | 0 13 11                                |
| Water emulsion of Indian pyrethrum extract<br>(formula A) .. .. .   | 0 7 9                                  |

The total cost (materials, labour, etc.) of spraying in villages with water emulsions during one season of 22 weeks has been approximately :—

Sendakkottai (population : 1,645) using emulsion A—3 annas *per capita*.

Tamarankkottai (population : 7,620) using emulsion B—4 annas *per capita*.

#### Use in the field

In practical use, a spraying overseer took to the field only the *stock extract*. Each morning, before starting his spraying rounds, the overseer would prepare the *emulsion* required for the day. It is essential that the emulsion be freshly prepared every day, as pyrethrins in an emulsion quickly lose their toxic properties.

Before a quantity of the emulsion is poured into a spray-gun, this stock container should be thoroughly shaken. During spraying, the labourers soon learn to keep the emulsion in good suspension by frequently shaking the spray-gun.

#### Other emulsifiers

Probably any commercial emulsifier would be suitable for making a water emulsion spray such as we reported here. Other experiments, for example, were conducted with Permal EML, which was available in India. It was satisfactory when made up in the following formula :—

|               |    |    |            |
|---------------|----|----|------------|
| Stock extract | .. | .. | 1 gallon   |
| Water         | .. | .. | 7 gallons  |
| Permal EML    | .. | .. | 2.4 pounds |

Costs will vary somewhat according to the prices of the emulsifiers. It is quite likely that some suitable local product may be found. Ordinary soap was fairly good if the water was quite soft, but was found unsatisfactory for use with hard water. Soft water was seldom available.

#### Summary

This paper reports a water-emulsion pyrethrum spray which is cheap and effective. Its advantage is low cost. The disadvantage of slightly heavier droplets of a water instead of a kerosene spray can be overcome by properly

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## A MODIFIED METHOD OF RETICULOCYTE COUNT

By A. N. BOSE, M.B.

and

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In the assay of liver extract preparations, whether on pernicious anæmia cases or in laboratory animals, reticulocytosis has always been taken to be the index of therapeutic activity. When working with laboratory animals such as guinea-pigs or rabbits, it is essential that a rapid at the same time accurate method should be adopted for the counting of the reticulocytes. Usually workers have used some modified methods as have been suitable to them. During the study of Jacobson's (1935) guinea-pig method of liver extract assay, a large number of reticulocyte counts had to be done by us and certain difficulties overcome. It was found that a drop or two of the blood could not be properly oxalated; and with a highly oxalated blood the cells did not maintain their proper contour for a long time and tended to break up and undergo granular disintegration. A stain of brilliant cresyl blue more than 0.5 per cent in strength tended to throw out precipitates more quickly, whereas a stain of 0.5 per cent in physiological saline (0.9 per cent) kept fairly well for a long time. It was also noticed by us as well as by Napier and Das Gupta (1940) that wet preparations gave more accurate results and required less time than dry slide preparations. Clumping of red blood cells which tended to occur in certain specimens was always traced to be associated either with a defect in the strength of the saline taken for dilution or with the

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directing the spray nozzle and by using slightly greater amounts of spray material.

Practical tests in two villages with this water emulsion spray gave good results.

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concentration of the cresyl blue solution or a partly coagulated drop of blood. A peculiarity was, however, noticed in the case of reticulocytes. In specimens where the red cells were undergoing granular disintegration, reticulocytes stood out prominently without any signs of breaking up. Probably this was due to their reticular structure.

The following modification of Osgood and Wilhelm's method (1934) gave accurate results in counting :—

A 0.5 per cent solution of brilliant cresyl blue in 0.9 per cent NaCl was kept in stock in the ice chamber. When required, small amounts were taken and used for 4 to 5 days. After a time, an initial centrifugalization at high speed for one hour was done to separate out any particles which had precipitated from the stock stain. Blood was taken direct from an ear vein by a needle puncture. One drop of blood and 4 to 5 drops of the stain were thoroughly mixed over a clean glass slide and then taken by a narrow pipette into a Kahn tube containing a small volume (about 1 c.cm.) of sterilized and absolutely clear saline of 0.9 per cent strength. The tube was immediately placed in a water-bath at 37 to 38°C. for 5 minutes. After this, a small drop was taken on a slide, a large rectangular coverslip was placed over it, and the specimen examined under the oil-immersion lens. At least 1,000 to 1,500 corpuscles were counted from one end to the other. Percentages of reticulocytes were then calculated from the total counts. Any slide which showed stain particles along with the corpuscles was rejected without counting. The advantages of this method are :—

- (a) the reticulocytes stained very distinctly,
- (b) the red blood cells remained separate and discrete without showing any tendency towards clumping,
- (c) the specimen remained completely free from any stain particles which previously used to interfere much with the identification of genuine reticulocytes,
- (d) owing to the dilution with saline in the Kahn tube the number of corpuscles in one microscopic field was reduced and thus it became very much easier to count them without the use of an Ehrlich's eyepiece or some similar device as is used by other workers.

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[Note.—Dr. C. R. Das Gupta has tested this method, but did not find that it exhibited any advantages over the method (Aii) described by Napier and Das Gupta; also it took longer to carry out.

The method of testing liver extract described by Jacobson is not a generally accepted method for testing the efficacy of liver extracts.—Editor, *I. M. G.*]

## FURTHER WORK ON PYRETHRUM IN THE TREATMENT OF PEDICULOSIS

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and

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AMONG the various substances used for controlling the infestation of the head with louse, mention may be made of kerosene, xylol, oil of turpentine, cresol, lysol, acetic acid, etc., but none of them is satisfactory as either it has no action on nits or it causes considerable irritation of the scalp especially when the skin presents an eczematous condition which is so often caused by head-lice.

In a previous communication reference has been made of the good results obtained in the treatment of human louse infestation with pyrethrum (Roy, Ghosh and Chopra, 1941). The important point which came to light may be recapitulated. Pyrethrum prepared in the form of an extract by heating the powder in water or mixed with white vaseline proves fatal to lice, but fails to act on nits. This necessitates the continuation of the treatment during the whole period extending over the incubation period of eggs.

Observations made in Calcutta by the wristlet method indicate that the duration of the egg stage varies from 5 to 8 days in summer and from 7 to 10 days in winter.

It will thus be seen that though pyrethrum used in the forms stated above efficiently acts on adults yet suffers from the disadvantage that it does not act on nits on account of the fact that it cannot penetrate either the egg-shell or pass through the operculum.

We now present a report on the remarkable efficacy of a mixture of kerosene and pyrethrum, or deobase oil and pyrethrum in the treatment of infestation with louse. It has certain definite advantages over other forms of treatment in that only one application is necessary and according to our experience eggs and adults are always destroyed.

As a rule louse infestation among hospital patients is not so common in this country, possibly owing to the free use of oil and practice of taking daily baths. However, a large number of the female patients, all evacuees from Burma, who were admitted into the hospital for treatment of other diseases, had lice in their hair and the infestation was as a rule heavy. This opportunity was made use of to test the usefulness of pyrethrum in louse infestation of the hair. Before the actual tests were undertaken on man, preliminary tests carried out on monkeys had proved encouraging.

In all, 26 patients were treated, 24 being females. The method of treatment followed was the spraying of every part of the hair from the root to the tip with an extract of pyrethrum,

diluted with either kerosene or deobase oil, by means of a De Vilbiss atomizer No. 15. The extract used was Pyresect 25\* which was diluted with 24 times its volume of kerosene or deobase oil immediately before use. The taking of a bath within 12 hours following the treatment was in the beginning forbidden, though later observations made it clear that as soon as pyrethrum entering through the operculum came into contact with the embryo inside the egg-shell, the latter was killed, and therefore it would be unnecessary to restrict bathing for more than an hour or so after the treatment. Only one application was required to effect complete cure of their pediculosis in every case. - Laboratory experiments clearly showed that the egg-shell is impermeable to kerosene and also to a mixture of kerosene and pyrethrum. On the other hand, application of a minute drop of pyrethrum in kerosene or deobase oil on the operculum of nits always destroys the embryo. This is in contrast to the application of kerosene alone in which case a very large proportion of nits so treated will hatch.

\* Pyresect 25 was kindly placed at our disposal by the supplier, General Export Co., 1, British Indian Street, Calcutta.

It is clear that pyrethrum is not only toxic to adults but also to nits for which a direct contact is essential. The reason why kerosene acts on adults, though the action is uncertain, but fails to act on nits, is the fact that it cannot penetrate the operculum; this pyrethrum in kerosene or in deobase oil readily does. A marked alteration of the surface tension may be accepted as the explanation. Thus a drop of kerosene poured on water has the tendency to collect in one place, whereas kerosene-pyrethrum will quickly spread over a large area of the surface.

Patients treated with kerosene-pyrethrum mixture have not been known to complain of any irritation of the scalp even when superficial ulcerations were present. It is liked by them on account of its containing a drop or two of oil niroli, which is always added to the mixture in order to make the smell pleasant.

Those with long hair require from  $\frac{1}{2}$  to  $\frac{3}{4}$  oz. and those with short, less than  $\frac{1}{2}$  oz. of the mixture.

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## A Mirror of Hospital Practice

### GIARDIASIS—TWO CASE REPORTS

By D. N. SEN GUPTA, M.B., D.T.M.

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ON 20th October, 1941, I was called in to see a female patient, aged 30 years, who had been ailing for more than a year and was suffering from terminal broncho-pneumonia and I was given to understand that she was very seriously ill.

The condition on my first visit was as follows :—

She was very emaciated, toxic, prostrated and dyspnoic. Temperature—103°F. (axillary). Pulse—140, with low volume and tension. Respiration—60 per minute and shallow. Lungs showed signs of broncho-pneumonia. Cyanosis was present. Cough was incessant and hacking with muco-purulent sputum.

*Previous history.*—She was a mother of 5 children—last issue one and half years back. Complaints started as dysentery one year ago. The symptoms, especially diarrhoea and flatulence, persisted in spite of various treatment. During the whole period of illness she lost about 40 pounds in weight. She was kept on a very low diet.

*Treatment and progress of the case.*—I put her on M.&B. 693. The temperature was normal on the third day and the lung condition improved, but troublesome diarrhoea started—loose frothy evacuations with mucus about 6 times per hour. The stool was examined microscopically—*Giardia intestinalis* cysts and vegetative forms were found. M.&B. 693 was omitted on

account of diarrhoea and bismuth with opium was given to control it.

On the fifth day the temperature was 99°F. to 100°F., diarrhoea was checked and M.&B. 693 given again but diarrhoea recurred. The stool was again examined; it showed a heavy giardia infection.

Next morning the pneumonic condition having settled down and the patient being free from toxæmia, atebirin 0.3 gram daily was given after food. On the fourth day of atebirin, she passed firm stools twice. On the fifth day she developed atebirin psychopathy and was violently delirious. Peacock's bromide and adalin were prescribed that settled down the condition within 24 hours. She was given an acid mixture and high protein diet. She had no more flatulence and diarrhoea. She gained weight and developed a voracious appetite. Her stools were examined for three consecutive days and no giardia was found.

Some time later I had another similar case.

This case was a woman, aged 18 years, after the first childbirth had been suffering from chronic flatulent diarrhoea for one year. She was treated along various lines, on a very restricted diet, with no improvement.

On my first visit I examined the stool microscopically and found giardia, vegetative and cystic forms, in large numbers. No atebirin was available in the market, so she was put on acid mixture and stovarsol. She improved so long as stovarsol was continued, but diarrhoea recurred when the drug was discontinued.

With great difficulty one phial of atebirin was procured by the patient's relative at a fabulous price. She was cured with one course only. Stool was repeatedly examined but no giardia was found.

## A CASE OF ACUTE BACILLARY DYSENTERY TREATED WITH M.&B. 693

By B. M. CHATTERJEE, M.B.

*Assistant Surgeon, Tangail Subdivision and Hospital*

ON Monday, the 16th March, 1942, at about 10 p.m. I was called in to see a boy, aged 12 years. According to the history given by the relatives, the boy was passing frequent loose motions with mucus and blood for the last few days. On the day when I was called, the boy passed about 40 stools.

On examination, I found the boy to be in a desperate condition. He was very restless, and complained of severe griping pain in the lower abdomen associated with tenesmus. Temperature was 101°F., pulse 120, and respiration 22 per minute. The tongue was coated and dry. Tenderness was present over the lower abdomen. Stools were passed every 10 to 15 minutes, alkaline in reaction and consisted of abundant mucus, blood and greenish sloughs. Faecal matter was entirely absent. For want of proper facilities microscopical and cultural examination of the stool could not be done. Clinically, the case was diagnosed to be acute bacillary dysentery.

M.&B. 693 was prescribed, and considering the desperate condition of the boy, a moderately heavy dose of 1.5 gramme of sulphapyridine was given by mouth in powdered form immediately. Along with general resuscitative measures the drug was repeated in the same dose once more, four hours afterwards in the night. Next morning, I came to know that after the first dose of M.&B. 693, the number of stools became less frequent and the boy slept for some time. The general outlook of the patient in the morning was much better. Griping pain and tenesmus diminished to a marked extent. Stools passed in the latter part of the night showed marked diminution in the amount of blood and greenish sloughs, and the M.&B. 693 powder was found to be present in the stools. Another 3 grammes of the drug were prescribed for the day, and stools completely stopped after 12 noon of the very day. There was absolute constipation for three subsequent days and afterwards the boy recovered uneventfully.

The miraculous efficacy of sulphapyridine in the treatment of acute bacillary dysentery has been recently reported by Bell (1941) and Lapping (1942). The presence of the sulphapyridine powder in the stool in the above-mentioned case shows that the drug acted locally on the large intestine. To decide whether the abatement of symptoms was due to the action of the drug on the dysentery group of organisms, or due to action on the associated streptococcal infection, requires further investigation.

I am thankful to Dr. P. R. Das Gupta, civil surgeon, Mymensingh, for kindly allowing me to publish the report of this case.

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## BACILLARY DYSENTERY TREATED WITH M.&B. 693

### A CASE REPORT

By B. MUKHERJI, M.B., D.P.H.

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BACILLARY dysentery is rife in India and the mortality is particularly high amongst the

younger age-groups. The public health measures adopted to control or eradicate the disease are far from being satisfactory even in cities and towns, not to speak of rural areas which constitute the major part of India. Taking these facts into consideration if a quick and radical treatment can be instituted at a cheap rate, it will be greatly welcomed from all quarters.

Reitler and Marberg (1941) successfully treated 20 cases of bacillary dysentery of various types with sulphapyridine with the result that all were cured within 48 to 72 hours after the drug treatment was started. Later on, Bell (1941) used it in an epidemic of bacillary dysentery at a colony in Southampton where all his fourteen cases recovered in the same space of time. Whereas in the former series there were no relapses, in the latter there were two relapses who were successfully tackled within 24 hours by the same drug.

A boy, aged 3½ years, was attacked with bacillary dysentery at Lucknow on 1st May, 1942, and was frequently passing dark green-coloured stool with plenty of mucus and fresh blood. He was put on homœopathic treatment on the same day. Fresh blood disappeared from the stool on the next day, but no other improvement regarding other symptoms followed within the subsequent two days. On 4th May he was put under the local medical practitioner who put him on castor oil and later on phage (intestinal and dysentery) at usual intervals. No improvement occurred till the 6th evening when the case was brought to my notice. The stool was at once sent for an examination and ordinary microscopic examination revealed it to be a case of bacillary dysentery (plenty of blood corpuscles with a few epithelial cells—no amoeba detected; reaction alkaline). He was put on M.&B. 693 receiving 1.25 gm. on the first day. With the administration of the second dose the character of the stool began to improve; yellow flakes appeared and the dark green colour was replaced by a lighter one. On the second day 1 gm. of sulphapyridine was administered and towards the evening he began to pass formed stools of yellow colour and with practically no mucus. Number of motions diminished from six on the 6th to two on the 7th, and the temperature which was never above 99.6°F. fell down to normal. On the third day only 0.5 gm. of the drug was administered and he passed a normal formed stool. Thereafter, he was observed for one week more but no relapse occurred.

Diet included milk and barley water for the first four days, with occasional substitution of whey for barley water, followed by light rice diet and a seer of barley water every day.

Further trials with this drug will be awaited with interest as no definite conclusion can be drawn from a single case like this.

My thanks are due to Dr. Gupta, Lucknow, for kindly examining the stool and giving the diagnosis.

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REITLER, R., and MARBERG, K. (1941) .. *Brit. Med. J.*, i, 277.

[Note.—Our contributor has referred to foreign publications, but seems to have overlooked Dr. Lapping's report in the February number of this journal. Sulphapyridine has been used by several workers in this country, but so far not always with uniformly good results.—EDITOR, I. M. G.]

# Indian Medical Gazette

AUGUST

## THE TRANSMISSION OF KALA-AZAR

MALARIA has been recognized as a clinical entity for some thousands of years and as long ago as the Vth Century B.C. the most characteristic clinical signs were described accurately by Hippocrates.

Malaria takes many forms and it was looked upon by the physicians of the early days of the present era of scientific medicine as the standard fever of the tropics, on which main theme nature was capable of playing an infinite number of variations; but it was credited with a much more protean pathogenesis than it really possessed, and gradually certain clear-cut clinical types which appeared to have distinguishable epidemiologies emerged from the morass; amongst these were blackwater fever, about which our predecessors were—we now believe—wrong, and typhus, typhoid, yellow fever, relapsing fever, trypanosomiasis, and many other fevers, including kala-azar, about which they were right. This differentiation was aided by the introduction of the cinchona alkaloids in the treatment of malaria.

Then came Laveran and his discovery of the malaria parasite, and we have no doubt that many of the scientists of these days thought that all doubts regarding the relation of malaria to the other fevers of the tropics would soon be cleared away, but, although this discovery undoubtedly heralded a very great advance in our knowledge of tropical fevers, the immediate results were not all beneficial; a little knowledge once more proved a dangerous thing, for as malaria was so universally present in the tropics, malaria parasites were occasionally found in cases of typhus, typhoid, yellow fever, relapsing fever, trypanosomiasis, and kala-azar, and the issue was thereby confused. In the case of many of these diseases that had well-recognized syndromes, the syndrome survived and doubt was cast on the specificity of the malaria parasite; in the case of others, the malarial parasite won the day and the diseases temporarily lost their identity and were considered special forms of malaria. Amongst the latter was kala-azar.

By the middle of the XIXth Century and probably much earlier, kala-azar was recognized as a clinical entity—locally at least, for little about the disease had found its way into medical literature. An epidemic that started in Burdwan and spread throughout Bengal and the first recorded Assam epidemic of 1872 were recognized as being different from malaria. When the second Assam epidemic started and depopulated certain areas in that fertile country, officers were deputed from Bengal to investigate the cause. Many fell into the partial-correlation trap; for example, Giles in 1890 finding that a number

of patients with kala-azar had ancylostomes in their intestinal tracts—as indeed have nearly all the inhabitants of that country—described it as ‘undoubtedly ankylostomiasis’, and, even later, when the giants of medical research, Rogers (1897) and Ross (1899), were called in, they gave their considered opinions that it was a particularly resistant form of malaria. Thus, in the twenty years since Laveran’s discovery, matters had retrogressed.

In 1903, Leishman and Donovan independently discovered the causal organism of kala-azar. The method of demonstrating the parasites during life presented no difficulties and therefore a definite diagnosis could be made. It was now possible to separate kala-azar from malaria with greater accuracy, and further the disease which had hitherto only been recognized in India was found to occur in other countries, e.g., China and the Sudan; and other recognized clinical syndromes, e.g., *ponos* in Greece, were found to be caused by the same, or at least by a morphologically identical, parasite. So ended the first phase in the investigation of the aetiology of this disease.

The next question that naturally arose was—how is the disease transmitted to man? Investigations were started almost immediately, and Patton in Madras was one of the earliest investigators. He showed first that the causal parasite, *Leishmania donovani*, was always present in the peripheral blood and not demonstrable in the secreta or excreta (subsequent investigations showed that it is recoverable from the stools, urine and nasal secretions in special circumstances). One of the earliest insects with which he experimented was the bed-bug; he found that the parasite survived in this insect for a considerable time and multiplied if the bug did not take another blood meal, but that, if it did, the infection was likely to be killed. For some years, all work by experienced investigators such as Patton, Cornwall, Adie and Knowles was concentrated on the bed-bug, but little advance was made; the bug was at best a poor culture medium, only a very small percentage of bugs that took an infected blood meal became infected, and in them the infection was very light and often transient.

The 1914-18 war interfered with research work, but immediately after the war, when the School of Tropical Medicine in Calcutta was opened, a special kala-azar research department supported by the Indian Tea Association was included in the scheme; Napier was appointed to this post and with Knowles, a more senior member of the staff with previous experience of the subject acting in an advisory capacity, and the staff of the protozoological department, including B. M. Das Gupta, co-operating, a new attack was made on this problem. It was decided that an entirely fresh start had to be made and a thorough epidemiological study of the disease in Calcutta was carried out by Napier. Certain observations



made by him regarding the distribution of the disease seemed to indicate that it would be possible to narrow down the scope of any special investigations to one particular quarter of the town. The Calcutta inquiry was strengthened by the addition of Smith, appointed under the Indian Research Fund Association to act as medical entomologist, in May 1924. The earliest investigations showed that of those under suspicion, excluding the bed-bug on account of its ubiquity, the insects most constantly present in the endemic quarter in Calcutta were sandflies, *Phlebotomus minutus* and *Phlebotomus argentipes*. As the former was reputedly not a human-blood feeder, experiments were first carried out with the latter. No infected flies were found in nature at that time, but it was thought that clean laboratory-bred flies ought to be used, and after a short delay while the technique of breeding these was learnt, in the very first batch of these flies fed on kala-azar patients, 40 per cent were found to develop a heavy flagellate infection in their mid-guts (Knowles, Napier and Smith, 1924, *I.M.G.*, 59, 593).

In the same year the Indian Research Fund Association's Kala-azar Commission, with Christophers, Shortt and Barraud were starting work in Assam. They too had decided on a completely unprejudiced approach and were first exploring the possibilities of oral infection; when however the observations regarding the development of the parasite in *Phlebotomus argentipes* were made in Calcutta, they immediately switched over their full attention on to this sandfly and very soon were able to confirm the Calcutta findings. The Kala-azar Commission carried the matter much further and were able to show that the infection in the sandfly progressed forwards to its mouth parts, so that when the fly took another blood meal it must almost inevitably contaminate the wound with flagellates and thereby transmit the infection. At this stage, help was received from outside India by the discovery by Young, Smyly and Brown that the Chinese hamster was very susceptible to leishmania infection and a large consignment of these animals was received from Peiping. It was by this time felt that the problem was almost solved, but attempts to transmit the infection to hamsters by means of the sandfly's bite were singularly disappointing. However, Shortt, Smith, Krishnan and Swaminath (1931), and Napier, Smith and Krishnan (1933) succeeded in infecting one and two hamsters, respectively, in this manner. But all attempts to transmit kala-azar to volunteers failed, so that at the end of nearly ten years since the initial incrimination of the sandfly, *P. argentipes*, by Knowles, Napier and Smith, the final and conclusive proof was still wanting that this sandfly could actually transmit kala-azar to man.

However, despite the failure of the crucial experiment and certain confusing observations,

such as the finding of the parasite of kala-azar in nasal secretions, most protozoologists considered that the circumstantial evidence against the sandfly was sufficiently strong for this mode of transmission to be accepted as a working hypothesis, and means for controlling sandflies were therefore investigated. Most of the workers themselves felt certain that the sandfly was the transmitter, and that it was only a matter of time and the discovery of the particular 'trick' for experimental transmission to be effected at will. (The disease had been transmitted to three hamsters by sandflies, but it was the many failures that needed explaining.)

The general opinion at this time is well represented by Napier's summing up of the position in the *British Encyclopædia of Medical Practice* which reads as follows:—

'So far as India is concerned, every epidemiological observation fits in with the sandfly hypothesis of transmission. Further, this sandfly has actually been found in large numbers in every locality where kala-azar occurs; it is a persistent human-blood feeder; a large percentage of the flies that feed on an infected person acquire the infection; infected flies have been found repeatedly in nature; this is not true of other sandflies which are more prevalent in the non-endemic areas, nor in insects of any other genus so far experimented with; in this fly an anterior development of the flagellate infection occurs and is unlikely to be purposeless (in natural flagellate infections which pass from insect to insect the development is usually posterior); and it has been shown experimentally that the fly is capable of transmitting the infection to a mammalian host by its bite. All these facts make it almost certain that this insect is an important agent in the transmission of the disease from man to man in nature, although it may not be the only agent.'

The Kala-azar Commission was disbanded in 1931 and the main Calcutta inquiry three years later, and the principal workers turned their attentions to other matters. However, in 1939 work on kala-azar was resumed at the instance of the local governments in certain provinces where it was thought that the disease was showing signs of recrudescence. Smith was again appointed under the Indian Research Fund Association and the inquiry was located in Bihar. The work was primarily a bionomical and ecological investigation of the sandfly, with special reference both to the mechanics of transmission and to the possibilities of sandfly control.

Smith made some very important observations, namely (i) that after its primary blood-meal the sandfly could be kept alive for weeks by feeding on fruit juice, (ii) that, if after a primary infected feed the sandfly was given another blood meal, the flagellate infection was likely to be knocked out or at least its activity was reduced, but that if the sandfly was fed on raisins, the leishmania infection increased until the whole pharynx of the fly was blocked with

flagellates, and (iii) that flies thus 'blocked' with heavy leishmania infection, although they attempted to feed when given an opportunity, were unable to draw any blood, despite very violent efforts to do so; during these efforts it was certain that portions at least of the flagellate block became detached and entered the wound made by the proboscis.

Whilst it could truly be said that none of these observations was entirely new (e.g., the standard method of keeping mosquitoes alive is by feeding them on raisins and the method has been previously applied to sandflies, the observations that subsequent blood-meals knocked out the flagellate infection had been made by Patton, a quarter of a century ago in his bed-bug experiments, and the 'blocking' had already been observed histologically by the workers of the Kala-azar Commission with reference to this sandfly and has of course long been recognized in the flea in plague transmission), yet Smith's perfection of the technique was undoubtedly the most important step in providing the final proof that the sandfly *P. argentipes* can transmit the disease to man; the next two steps followed naturally when opportunity arose.

Smith, who was now able to produce these blocked flies more or less at will, first placed them to feed on hamsters, and obtained a very high infection rate amongst his experimental animals, and he would in the ordinary course of events have conducted the final experiments with human volunteers, but was recalled to military duty. This experiment was entrusted to Swaminath, one of the earliest and most constant workers on the kala-azar transmission problem, who, with the administrative assistance—and no doubt expert technical advice—of H. E. Shortt and L. A. P. Anderson, Inspector-General of Civil Hospitals and Director of the Pasteur Institute, respectively, in Assam where these experiments were being conducted, repeated Smith's experiments with human volunteers. Six volunteers, who lived in a hill district in Assam where kala-azar does not occur, were selected, and infected flies were fed on them; a paper that is at present in the press reports that at least three of these volunteers have contracted kala-azar. The hypercritical might say that this does not prove that this is the way kala-azar is *always* transmitted. It is true that this isolated experiment would mean nothing more than that it *can* be transmitted this way, but taken in conjunction with all the rest of the observations that have been made on this disease, every scientist will, we believe, agree that this experiment has removed the last objection to the already generally accepted conclusion that the *usual* method of transmission of kala-azar is by the agency of the sandfly, *P. argentipes* in India and other allied species in other countries.

An attempt has been made to give a consecutive account of the investigations that led to the final solution of one of the few outstanding problems regarding the transmission of the major

tropical diseases. A very fair criticism would be that only work in India has been mentioned. Very important and valuable work on this problem has been done by a number of foreign workers, for example, the Sergeant brothers' very suggestive experiments with sandflies and oriental sore in North Africa in 1921, which were confirmed and developed by Adler and Theodor, the later work of Adler on kala-azar in Europe in which the *P. perniciosus* was incriminated as the vector, the collateral work in China by Young, Hertig, Meleney, Patton, Hindle, Faulkner, Zia, Yung Sun, and many others, which showed that *P. chinensis* of the *P. major* group of sandflies was an efficient carrier, and the more recent observations by Kirk and others in the Sudan; all this work has encouraged the Indian workers and led them to believe that they were working along the right lines, but it actually started no new lines of thought, and it bridged no gaps in the road to the final goal, as far as the transmission of kala-azar in India was concerned.

At least three of the active supporters of the sandfly hypothesis have not lived to see their beliefs justified; during the last ten years, Young, Knowles and Acton have died. Though the last-named took little active part in the work on kala-azar, his belief, based analogously on his observations on oriental sore in Iraq, that the sandfly was the transmitter inspired all these who were associated with him.

## Special Article

### FILTERS AND FILTRATION

WITH SPECIAL REFERENCE TO THE FILTRATION OF BLOOD PLASMA AND SERUM FOR TRANSFUSION PURPOSES

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and

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#### Introduction

WITH the starting of blood banks in India certain commonplace laboratory procedures, such as filtration, have assumed considerable importance. Located as India is at present with her usual supplies from abroad cut off, workers in blood banks in this country are faced with the problem of obtaining suitable filters for their work. While drawing up proposals for the blood bank in Calcutta, it was found that use could not be made *in toto* of filtration procedures adopted by blood banks in the West for want of appropriate material. Various alternative methods and materials had to be thought of. In connection with that a review on filters and filtration was prepared and in the hope that persons interested in filtration will find it useful it was submitted for publication.

### Definition

Filtration is the process by which solids suspended in liquids and in an extended sense solids or liquids suspended in gases, are separated from one another by means of a false partition. This partition is called a filter and it blocks the passage of suspended matter while allowing the fluid in which it is suspended to pass through.

### Filters

It is common knowledge that there are many kinds of filters in the market prepared from a variety of material. Some are simple while others are slightly more complex, but each type has its own special use. In order to be able to choose correctly the type of filter required for any particular work one must know the different basic materials used in making the different types of filters, and their advantages and disadvantages.

The materials commonly used in making filters are cotton, paper, glass, asbestos, sand, clay or other forms of earth, plaster of paris, charcoal, collodion and gelatin. A brief description of these materials and of the filters made from them and their uses are given below :—

**Cotton.**—Cotton is the carbohydrate, cellulose. On account of its filamentous nature, it is used as filter in one of two forms—(i) as cotton-wool and (ii) as woven cloth.

Cotton-wool is prepared in two forms—absorbent and non-absorbent. While absorbent cotton is a useful clarifying agent for liquids both the absorbent and the non-absorbent types are useful for filtering gases. The familiar cotton-wool plugs in test-tubes containing media for bacterial growth in fact act as bacterial filters for the air that enters the tubes.

Cloth, lint and gauze are forms of woven cotton which are sometimes used as filters for clarification and under suitable conditions they yield filtrates which are quite clear.

Recently, Bushby and Whitby (1941) have employed a patent preparation called 'perfecta pulp' for clarifying blood plasma by removing the suspended fat globules. It is said to be made of pure cotton.

**Paper.**—Paper, like cotton, is a form of cellulose. Unsized paper, i.e., paper which has not been glazed, has a porous texture and is in principle filter paper. But good filter paper of constant porosity is prepared by more refined methods. Papers of graded porosities designated by numbers are on the market. The numbers are given by the makers and with each number its uses are also given. The number of paper chosen will depend upon the purpose for which it is needed.

Apart from the ordinary kind of filter paper, special forms are also available for special purposes. For example, ordinary filter paper is acted upon by strong acids and alkalies, and therefore a special kind of filter paper which is resistant to these has been manufactured. This is produced by changing cellulose into a

gelatinous form called 'amyloid' which is resistant to acids at ordinary temperature. It is however relatively less porous. Parchment paper is also prepared in a similar manner, but it is gelatinized to a larger extent. As yet there is no method of standardizing this gelatinizing process to obtain different porosities. If that could be done, excellent bacterial filters could be made out of gelatinized paper. There are also filter papers specially prepared for other types of work. For example, a fat-free form is prepared for use in fat estimations and an ashless form in gravimetric chemical analysis. Special types are also available for filtering oils called 'Postlip thick grey' and for colloidal material called 'Chardin'.

Paper pulp is also used in filtration. It is supplied in the form of compressed slabs. These are broken up in hot water and ground up until the mass is of an even soft consistency. For use, the pulp is placed into a Buchner funnel of which the holes are covered by ordinary filter paper and by gentle hand pressure and suction the pulp is made into a pad. Such a filter is efficient in clarifying protein solutions.

**Glass.**—Glass, a mixture of silicates of calcium and sodium, is used in filtration in the form of glass wool or sintered glass discs. The former is a very familiar form and is used for rough clarification. Its main advantage is that it can be used with impunity with acids and alkalies. Glass wool is not difficult to prepare. A process known as 'the bow and arrow process' is employed in making it. In this process heated glass in the plastic stage is shot through with a bow and arrow type of arrangement and the long thin filaments formed are wound round a drum. By keeping the drum rotating all the time a continuous stream of glass fibres is drawn out from the plastic glass.

Sintered glass filters are also available in the market. These filters are made by spreading powdered glass of uniform degree of fineness into a uniform layer over mica plates and then heating them in ovens to a high temperature to enable the pieces just to fuse into a porous plate. This process is known as sintering. The surfaces of these plates are ground rough with emery and cut into proper discs which are later fused into suitable holders. Filters of varying porosities are available and recently some bacterial filters have also been produced. These have an average pore diameter of  $0.9\mu$  which though very much larger than the smallest bacteria ( $0.2\mu$ ) serve well as bacterial filters in practice, probably due to the clogging of the pores during filtration. The firms employ a code designation for the porosity of these filters. On the filter is stamped one letter between two figures, as for example, 1G3. The first figure indicates the type and size of the filter, the capital letter the quality of the glass and the last figure refers to the porosity of the filter disc. Sometimes the letter 'P' is added to the designation of the filter. This means that the filter disc is ground

plane and polished. For bacteriological work the filter is designated G5 on 3 which means that 2 discs of porosities 5 and 3 are fused one over the other. These filters are easy to clean and sterilize and can withstand temperatures up to 120° and 150°C.

**Asbestos.**—Asbestos is a double silicate of calcium and magnesium. It occurs in the form of large sheets consisting of layers of long crystals. It has a filamentous texture and can be processed into a woolly consistency or ground into a pulp. This asbestos wool or pulp can be used as such or after being pressed into pads. Pads of asbestos incorporated with paper pulp are sold by the German firm of Seitz in two grades of porosities, K and EK; K for clarification and EK for bacterial filtration. They are available in different sizes—3 cm., 6 cm. and 14 cm. in diameter. There are also American and English equivalents of these pads. Suitable apparatus for mounting these pads for filtration are available in two types—(i) Manteufel and (ii) Uhlenhuth. These filters (particularly the latter) are becoming extremely popular in bacteriological work on account of their efficiency, cheapness and rapidity of action. They are also easy to handle and sterilize. It is this type of filter that is used in plasma and serum work both for clarification and sterilization. Further data regarding these filters are given later.

**Sand.**—Sand, the oxide of silicon, acts in nature as a filter when water percolates through the soil. It is used in the purification of community water supplies. The sand itself does not account for the whole of the filtering efficiency; it is the biological deposit of slime, that forms on the top of sand that acts as a true bacterial filter.

**Clay.**—Clay, the silicate of aluminium, when baked and unglazed as porcelain is much used in filtration. The popular form in which porcelain is used as a filter is a hollow tube, thimble or candle. Chamberland, a French worker, was the first to use them and later Pasteur, and hence the name, Pasteur-Chamberland filters. They are prepared in different porosities, designated in increasing order of fineness, as  $L_1$ ,  $L_1$  bis,  $L_2$ ,  $L_3$ ,  $L_5$ ,  $L_7$ ,  $L_9$ ,  $L_{11}$ ,  $L_{13}$ . The  $L_3$  candle is the commonest in use for bacterial filtration. The English equivalent is known as the Doulton filter, the German as the Massen filter, and the American as the Allen filter. These are made in one porosity only, approximating to Chamberland  $L_3$ . Recently porcelain discs held between rubber gaskets in a metal holder called Jenkin's filters have come on to the market.

**Keiselguhr.**—Keiselguhr is a siliceous earth of diatomaceous origin obtained from the Keiselguhr mines. The story of the value of this earth for filtration is interesting. It was first found that water from the Keiselguhr mines was of excellent quality and bacteria-free. Investigation revealed that the earthy bed

through which the water came was responsible for its bacterial purity. Use was made of this earth for the preparation of bacterial filters and these worked very efficiently. Filters made from this material were given the name of Berkefeld after the owner of the mines. They are shaped as hollow candles fitted to a metal nozzle and are sold in three grades of porosities, V, N and W. V or *viel* meaning coarse, N or normal, and W or *wenig* meaning fine. The English Berkefeld Company supplies filters of one grade only. These filters are extremely fragile and cleaning of the candles is a laborious and unsatisfactory procedure. There is also the danger of a leak developing at the junction of the candle with the metal nozzle. The American equivalent of these is known as Mandler filters, and the composition of these is slightly different. They are made of Keiselguhr, asbestos and plaster of paris. The proportions are varied to give three porosities which are graded according to the air pressure they withstand in water. They are called 'preliminary' (2 to 5 lbs.), 'regular' (6 to 9 lbs.) and 'fine' (10 to 16 lbs. per sq. inch). The Mandler filters are said to be stronger than Berkefeld.

**Plaster of paris.**—Plaster of paris, the semi-hydrate of calcium sulphate, becomes plastic on wetting with water and later sets. Recently, Kramer filters made of commercial plaster of paris either alone or combined with different quantities of magnesium oxide have come on to the market. They have been used for special purposes in which filters carrying a positive charge are required.

**Charcoal.**—Charcoal has been used in filtration, specially in connection with the clarification of sugar solutions and oils. In water purification for domestic purposes charcoal is, at times, employed.

**Collodion.**—The earlier filters made of collodion were those prepared by impregnating collodion on filter paper, but these filters were not of uniform porosities, nor could they be exactly reproduced when needed. The latest type of collodion filter is the Elford membrane. This is prepared from a solution of collodion in a mixture of absolute alcohol, anhydrous ether, acetone and amyl alcohol. The mixture is poured on to special plates and allowed to evaporate spontaneously under standard weather conditions and the film produced allowed to jelly by the addition of water. The resulting membrane is of uniform porosity and exactly similar membranes can be reproduced by employing the same identical procedure. The porosity of a membrane can be varied at will by the addition to the collodion solution of varying quantities of water to increase the pore, or acetic acid or ethylene glycol monomethyl ether, to decrease the pore. The actual pore size of any prepared membrane can be determined by noting the rate of flow of water through it and applying Poiseuille's equation. These membranes are sufficiently strong to stand

handling and pressure and are of great use in certain types of bacterial and ultra-filtration work.

*Gelatin.*—The use of gelatin as a filter material is now obsolete. But it is of historical interest in that many of the earlier investigations on ultra-filtration were carried out by depositing it on filter paper.

### *Purpose of filtration*

It is common knowledge that filtration is widely employed for a variety of purposes in several branches of science. So far as bacteriology is concerned it is used at least for four purposes:—

(1) To obtain fluids free from bacteria as in the filtration of water for drinking purposes which is done with the object of removing bacteria and suspended matter.

(2) To obtain bacteria free from the fluid in which they are suspended as in the isolation of pathogenic bacteria from water samples where filtration is done with the object of concentrating the organisms in the filter as a preliminary to their isolation.

(3) To separate organisms of different types from one another as in the filtration through collodion membrane of fluids containing a mixture of bacteria and viruses for keeping back bacteria but allowing the viruses to pass through.

(4) To clarify material used in bacteriological work as in the filtration of culture media which is done with the object of removing gross particles and obtaining filtrates clear to the eye.

In serum and plasma filtration in which we are primarily interested, filtration is done with the object of 1 and 4, i.e., sterilization and clarification. No doubt, theoretically it should be possible to avoid filtration of serum and plasma by the adoption of a strict aseptic technique and a closed system of collection, pooling and bottling. In fact, Dr. Strumia of the Bryn Mawr Hospital, Pa, advocates the aseptic closed technique and does not find any necessity to filter the plasma or serum he prepares. But most others in the West, as well as ourselves here, feel that, despite the adoption of a closed system and all-care in technique, contaminative bacteria do get introduced at some stage or other, and that these have to be removed. Under the conditions prevailing in India and particularly during the summer months, we find filtration essential and cannot be avoided.

### *Equipment required*

In order to carry out filtration, four main things are required as shown in figure 1. These are (1) the filter and its holder, (2) the vessel for holding the fluid to be filtered, (3) the receptacle for collecting the filtrate, and (4) a mechanical pressure system which will ensure proper rate of filtration.

### *Choice of equipment*

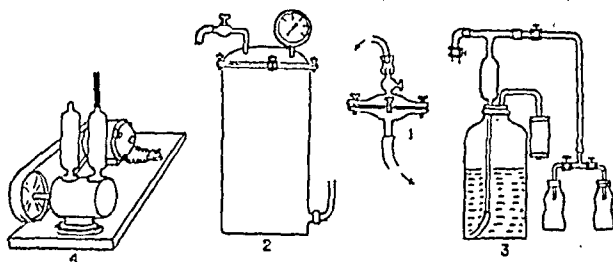
The choice of equipment for any filtration work will depend upon two important considerations—(i) the purpose of filtration, and (ii) the quality of the filtrate required.

As our main interest lies in the filtration of blood serum and plasma it may be pointed out that it is done for the purpose of clarifying and sterilizing the serum. And as regards the quality of the filtrate the requirements are that it should be free from bacterial and chemical contaminants and also have a chemical composition as near to its original as possible. From these two points of view let us consider the choice of equipment.

### *Choice of filter*

A suitable filter is the first requisite for conducting successful filtration. From the long list of filters already given it will be clear that we have a wide range of filters to choose from for the two purposes mentioned. For clarification we can choose cotton-wool, gauze, cloth, lint, filter paper, paper pulp, asbestos wool or pads, glass wool, sintered glass, charcoal or sand. And for sterilization we can choose special types of filters, such as, Pasteur-Chamberland, Doulton,

Fig. 1.



Massen, Berkefeld and Mandler, Seitz or Kramer filters. But before making the choice we will also have to take into consideration the chemical composition of the fluid to be filtered, its pH, its viscosity, and the nature of the filtrate we wish to obtain. English and American workers are using Perfecta pulp for clarification and Seitz filter for sterilization. But in view of the fact that these are not available in India, it will not be out of place to say a few words as to what these are and what substitutes can be used in their place.

Perfecta pulp is a patent article sold by Messrs. Becker & Co., in cakes about 12 inches  $\times$  12 inches  $\times$   $\frac{3}{4}$  inch, weighing  $1\frac{1}{4}$  lb. each and priced at 1s. 6d. per cake. The exact method of manufacture of this pulp is not known, but from the description in the catalogue it seems to be made out of 'pure cotton without any admixture'. It should not at all be difficult to manufacture this locally. Further, for clarification purposes for which it is used, suitable substitutes can be improvised. It is a familiar practice in protein laboratories to use filter paper pulp for clarification. This pulp is made by kneading pieces of filter paper with water and then pressing a pad of them on Buchner funnels.

It would be worth while experimenting with such a substitute and determining its efficiency. Theoretically it should prove successful. Since writing this article experiments conducted at the A. I. I. H. have revealed that paper pulp made as above and sterilized by autoclaving is quite effective for clarification. In fact the Institute blood bank uses it regularly for clarification of serum.

*Seitz Pilot filter.*—The Seitz Pilot filters are special large types of Seitz filters which can take 20 cm. square filter pads. Into these 8 sets of paired pads (a clarifying Ford FCB pad followed by a bacterial Ford S.B. pad) can be fitted. Its advantages are: (i) that a large filtration surface is obtained and 140 litres of serum can be filtered in one day using a filtration pressure up to 12 lb. per sq. inch, and (ii) that both clarification and sterilization can be effected in one operation. These filters are not available in India and there is no knowing when they will arrive even if indents are placed. Although there are advantages in using these instead of the ordinary Seitz filters which are smaller, yet the latter will prove, if properly used, equally efficient. Another advantage in using a Pilot filter is that positive pressure can be employed in working it. Though the ordinary Seitz filters are meant for working with negative pressure, the Uhlenhuth models can be used for filtration both under negative and positive pressures. In fact it is this type that we have recommended for filtration of serum in the Institute.

The pads used in Seitz filters are of German manufacture. There are also English and American substitutes of these. India had a very poor stock of German pads when the war broke out. Since then all available pads have been sold out. Fortunately the Institute has stocked a fair quantity of the pads. But they may not last long, specially as large numbers of these will be used in serum filtration. Thus the problem of obtaining a large stock of pads still remains, specially as the English and American substitutes have not yet reached India. Under the circumstances it would be worth while considering the manufacture of these in India or at least attempting to renovate the used pads. Ordinarily the pads are rejected after being once used. A few preliminary experiments on renovating these pads, i.e. making new pads out of the cast off ones, have been conducted and there is every hope that it may prove successful. Provided the renovated pads are proved efficient for bacterial filtration, our temporary difficulty in obtaining these pads can be overcome.

In the choice of a filter the second factor to be considered is the quality of the filtrate to be obtained. Judging from the available reports on the use of serum and plasma filtered through Seitz Pilot filters, we find that there are two objections to the use of these filters. One is the adsorption by the filter of some of the important constituents of the plasma and the other is the presence of magnesium ions in the

filtrate due to contact with the Seitz pads. As regards the first objection, it may be pointed out that all filters, other than glass and collodion filters, will adsorb a certain amount of the constituents in the serum, but that is not a very serious objection. As regards the second objection, it is important specially as the presence of magnesium ions in the serum has been held responsible for certain types of post-transfusion complications. These objections naturally raise the question as to whether other types of filters cannot be used with equal efficiency for serum and plasma filtration. It seems worth while investigating the possibility of using collodion or glass filters which approach nearer to the mechanical sieve. At least on theoretical grounds these should prove more satisfactory. They will certainly overcome the two objections raised against Seitz filters to a large extent.

#### *Choice of vessel for holding the fluid to be filtered*

In serum work as large quantities need to be filtered, suitable vessels for holding the fluid and feeding it to the filter are required. The ideal vessel for this purpose is one made of glass. Even where positive pressure is used glass bottles that can withstand the pressure would be the best. While some English workers use special aspirator bottles of 10 litres capacity (Greaves *et al.*, 1939), others (Bushby and Whitby, 1941) use copper containers. It is generally agreed that as far as possible it is best not to use metal containers for fear of contaminating the serum. Tinning or enamelling of these containers have been resorted to, to reduce the risk of metallic contamination. In America, they use monel metal receptacles. The only objection to using glass is that it may break easily and may not be able to stand high pressures. If metal containers are used they must be properly tinned or enamelled. They must also be fitted with pressure gauges and air-tight covers which can be held down by wing nuts. All joints should be protected wherever necessary by rubber washers. The one in use at the Institute is made of copper and tinned inside.

#### *Choice of receptacles for receiving and storing filtered serum*

As regards the choice of receptacles for collecting the filtered serum here again glass bottles of good quality fitted with air-tight screw caps are the best and they should be carefully chosen. The bottles recommended by M.R.C. are 'U.G.B. medical flat bottles' of 12 ounces capacity, while the R.A.M.C. workers recommend 'pint blood-transfusion bottles'. If bottles of the above specifications are not available in India due to war conditions, suitable substitutes may be used after proper testing. In the Institute, bottles made by Scientific India Glass Co., Calcutta, according to army standard pattern are used. These are of non-alkaline glass, 540 c.cm. capacity and fitted with metal screw caps inlaid with



rubber and having wire suspension hooks to keep the bottles in an inverted position during transfusion.

### *Choice of mechanical pressure system*

As regards a mechanical pressure system all types of filtration do not require this. The gravitational force of the column of fluid in contact with the filter is, in itself, sometimes sufficient to effect complete filtration. Even in such cases the application of pressure renders filtration easier and more rapid. In some cases, due to the high viscosity of the fluid to be filtered and due to the fineness of the pores of the filter, filtration is very slow or is impossible unless pressure is applied. In such cases either positive pressure on the input side of the filter or a negative pressure on the output side can be applied.

For obtaining positive pressure one or other type of air pumps is used. There are in the market several types of such pumps. Mention may be made of the following: (1) The ordinary cycle pump giving up to 5 to 10 lb. pressure. (2) The bigger types of hand pump giving up to 20 lb. pressure. (3) The various types of foot pumps giving up to 40 lb. (4) Gas cylinders containing compressed  $N_2$  giving up to 80 lb. (5) The rotary compression pumps giving up to 100 lb. or 200 lb. To any of these can be fitted a metal drum with a pressure gauge and regulator and from these the desired pressure can be got from one pound upwards.

As for obtaining negative pressure there are various types of exhaust pumps and mention may be made of the following: (1) The ordinary filter pump which can give a vacuum of about 25 mm. of mercury. (2) The hand Geryk pump giving a vacuum of about 0.02 mm. of mercury. (3) Rotary pumps single stage giving a vacuum of about 0.005 mm. of mercury. (4) Rotary pumps double stage giving a vacuum of about 0.00001 mm. of mercury. (5) Diffusion pumps using mercury or oil giving a vacuum up to 0.0000001 mm. of mercury.

In ordinary routine bacteriological work negative pressure pumps of the Geryk type are generally used, but in the filtration of plasma and serum there are certain advantages in using positive pressure, the most important of which are (i) avoidance of frothing of the filtrate, (ii) lesser chance of aerial contamination, and (iii) greater facility for bottling of the filtered product. It is on account of these that positive pressure is used instead of negative pressure. Here it may, however, be pointed out that when positive pressure is used the filtered serum or plasma will contain a larger percentage of dissolved gases.

For obtaining positive pressure one of the compressor types of rotary pumps giving a pressure of 25 lb. or more is recommended. This pump should also be capable of being regulated at will and being maintained without large fluctuations at any required level of

pressure. With such a pump it has been found that rapid filtration of large volumes of plasma or serum can be effected by adopting the following procedure: The filter is started at 5 lb. pressure per sq. inch and the pressure is then gradually raised over a period of an hour to about 9 lb. per sq. inch. Filtration is allowed to proceed at this level until the speed begins to slacken (which is usual in less than 4 hours) and then the pressure is further raised by steps of  $\frac{1}{2}$  to 1 lb. up to a maximum of 14 lb. per sq. inch in such a way as to keep the flow approximately constant. At the Institute a 'Kellogg' compressor is available. The compressed air, before use, is passed through a bottle containing heavy machine oil and glass beads, then through a sterile filtration 'F' Pasteur-Chamberland candle and finally through a sterile cotton filter 12 inches long.

### *Filtration room*

Apart from choosing the right type of apparatus required for filtration, it is also necessary to have a specially constructed dust- and draft-free room with a concrete floor, where filtration can be conducted under as sterile conditions as possible. This room should be so partitioned as to ensure a lobby, an outer room and an inner room. The lobby is to be kept as clean as possible but no attempt is made to sterilize it. But the outer and inner rooms have to be kept sterile. The lobby is used for changing into sterile garments, the outer sterile room for filtration and the inner sterile room for bottling and capping.

The question as to whether these rooms should be air-conditioned or not, has been raised, particularly in the tropics. In cold countries it is not done as it is not very uncomfortable to work in such closed draft-free rooms. But in the tropics, specially in summer, when 3 to 4 people have to work for a few hours inside these closed chambers, the question assumes a different colour. Although the process of filtration itself is not going to be greatly affected one way or another by air-conditioning, the comfort of the workers would certainly be affected. But it should be remembered that as these rooms have to be kept absolutely draft- and dust-free during filtration, either the air-conditioning will have to be stopped during the operation or the room in which the closed chambers are located will alone be air-conditioned or arrangements will have to be made for cooling the chambers without draft, or using cooled sterile air. At the Institute the air put in is 100 per cent fresh air which is cooled and filtered through a 'replacement filter' and again through a 'Visco filter'.

### *Preparation of apparatus for filtration*

This may be considered under three heads—(i) sterilization of the apparatus, (ii) sterilization of gowns and caps, and (iii) care of the filtration room.

1. Serum being an ideal medium for the growth of organisms it is imperative that all

apparatus coming in contact with it must be sterile. Sterilization of these is effected by steam at 15 lb. pressure for 40 minutes to one hour. Before sterilization they are properly cleaned and wrapped in muslin or cloth and packed in copper boxes to facilitate handling. During sterilization the cover of the box is raised slightly on one side to allow steam to enter, and it is closed when the autoclave is opened. The sterilization is done a day before filtration. If 48 hours or more elapse, the apparatus should be re-sterilized.

2. As sterile gowns and caps are worn by workers during filtration, these garments are placed in muslin bags and sterilized in the same way as the apparatus.

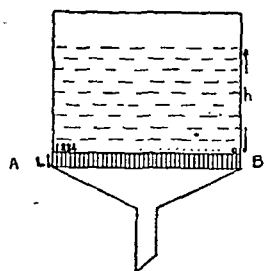
3. The room in which the serum is filtered must be kept clean and free from dust. It should always be subjected to a thorough preliminary cleaning on the day preceding filtration. Steam at 5 to 10 lb. pressure is blown in from a small autoclave for about 20 minutes to one hour. This produces a dense fog in the room which settles by the following morning. Immediately before filtration the table tops and other flat surfaces are wiped off gently with a sterile towel dampened in 1 per cent phenol or dettol solution. Check is kept on the efficiency of this sterilization by exposing a few blood-agar plates on the table while filtering and bottling are in progress.

#### Mechanism of filtration

It was stated previously that the chief function of a filter is to intercept particles in suspension or dispersion. Its action, therefore, from a theoretical point of view, may be considered as that of a mechanical sieve, but in reality it is not such a simple mechanical process. Due to the physico-chemical properties of the fluid undergoing filtration and of the material composing the filter the mechanism of filtration is a very complicated one. The theory of filtration may be explained briefly as follows :—

Imagine, as in figure 2, a filter AB with  $n$  straight pores, 1, 2, 3, 4, . . .  $n$  exposed to a

Fig. 2.



liquid standing above the filter at a height of 'h'. If the liquid is free from suspended particles, the rate of its passage through the filter is given by the classical formula of Poiseuille :—

$$V = \frac{\pi p r^4 t n}{8 L \eta}$$

where 'V' is the volume of liquid of viscosity

$\eta$  flowing through ' $n$ ' pores of average radius ' $r$ ' and length ' $L$ ' under a pressure head of ' $p$ ' in time ' $t$ '.

But since in a filtration the liquid contains suspended particles which are steadily being deposited on the filter and as a result the pores are steadily getting diminished in size, the above equation indicates the state of things at any given instant of time only.

Furthermore the filtration process in practice does not follow this simple rule because it is never true that the pores of a filter are straight and uniform and usually the form of the filter is such that it does not expose all filter pores to the filtration process to the same extent. Also the physico-chemical properties of the fluid including the suspended particles in it and of the material of which the filter is made influence the process; and particles much smaller in size than the pores of the filter are retained not by virtue of the impenetrability of the pores, but by electrical and other forces brought into action by virtue of the physico-chemical conditions prevailing. Thus, in certain cases even substances in solution may be retained by filters during filtration. It is on account of these reasons that when serum or plasma is filtered not only the bacteria and the suspended particles in it but also some of the important chemical constituents are removed from it.

#### Factors affecting filtration

From the discussion on the mechanism of filtration it will be clear that several factors other than the size of the filter pore determine whether in any particular instance filtration will be successful or not. The factors affecting filtration according to Rivers (1928) are :—

1. The electrical charge of the fluid undergoing filtration.
2. The electrical charge of the particles suspended in it.
3. The chemical nature of the substances present in the fluid.
4. The concentration in which they are present.
5. The pH of the fluid.
6. Presence or absence of electrolytes, oils, etc.
7. The temperature of the fluid.
8. The electrical charge of the filter.
9. The degree of pressure employed.
10. The duration of filtration.

In the filtration of biological fluids all these factors have got to be considered. In the case of plasma and serum many of the factors pertaining to the fluid to be filtered are known and are fairly constant. We need to be cautious only about (i) the choice of the filter, (ii) the pressure to be used in filtration, and (iii) the duration of filtration. Of these three factors the first two have already been dealt with and only the third remains to be discussed.

The period over which filtration can be allowed to proceed in any particular case is an important matter to decide. In filtration of protein solutions it is well known that the quality of the filtrate varies with time. It may improve with time in certain respects while deteriorating

in other respects. This is true particularly of bacterial filtration of serum and plasma. In the earlier stages due to adsorption by the filter of important constituents the quality is poorer with respect to some of them; but later as the filter gets saturated the quality improves. But in the case of plasma long-continued filtration may lead to early clotting of the filtrate. Again, from the bacteriological point of view, if a filter is used over a long period bacterial growth may take place in the filter and pass by contiguity into the filtrate. On account of these clashing influences an optimum time period has to be fixed. In the case of serum and plasma 4 to 6 hours are the upper limit.

### Conclusion

By way of conclusion it may be added that filtering is a process fraught with many possibilities of error and although filters of all varieties are guaranteed by the makers no filter can be called absolutely fool-proof. The process is by no means a simple matter and does not depend

entirely on the size of the pores and the amount of pressure applied. Various physico-chemical processes come into play and only through a proper appreciation of these, can successful results be achieved. As such there is need, specially in an important matter like serum filtration for transfusion purposes, for the filtration to be carefully controlled by one who understands the subject, and can avoid its many pitfalls.

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## Medical News

### SUGGESTIONS FOR FIGHTING LEPROSY IN INDIA

A COMPREHENSIVE report on the leprosy problem in this country has been made by the Committee appointed by the Central Advisory Board of Health to report on leprosy and its control in India.

The census figures, according to the report, give no true picture of the prevalence of leprosy. The 1931 census reported 150,000 cases, but leprosy surveys show the true incidence to be, on an average, about eight times this figure. In some highly infected areas the incidence may be from 5 to 10 per cent of the population surveyed.

While the problem of leprosy is primarily that of the disease in the general population, its presence amongst beggars causes much concern to the public. From the public health standpoint the problem of beggars with leprosy should not be ignored and the opinion that almost all such beggars are not infective is incorrect. The problem is most acute in Calcutta, Madras and Bombay.

The problem, it is suggested, needs to be tackled from several angles. Migration might be minimized by each province providing for its own leprosy cases. A profound change in public opinion is required to prevent the assembly of beggars with leprosy at festivals. There is a great need for a popular movement commanding the support of the public and of Indian religious and charitable organizations to work towards this end and for spending this money in constructive work, such as the provision of leprosy colonies, hospitals and clinics. A large increase in institutions for the isolation of infective patients is required.

An urgent need is the improvement of the teaching in leprosy given in medical schools and colleges; every doctor should know how to diagnose and treat leprosy and what precautionary measures should be taken against its spread. The report also gives a description

of a model provincial leprosy institution and recommends that, in every province where leprosy is common, such an institution should form the hub of anti-leprosy activities.

The Central Advisory Board of Health has commended the report to all Provincial and State Governments in the hope that the various recommendations will materially assist them in the formulation of a co-ordinated policy for anti-leprosy work, with special emphasis on the preventive aspect of the problem.

While emphasizing the need for public co-operation the Board considers that provincial and local authorities should aim at providing for the isolation of those persons who are in an infective stage of the disease. In anti-leprosy propaganda more use should be made of schools and teachers' training institutions. The Board also recommends the establishment of a 'Leprosy Institute of India', the appointment of provincial leprosy officers and amendment of existing legislation for the control of leprosy in the light of the principles recommended in the report.

### BLOOD PLASMA FOR AIR-RAID VICTIMS

It is understood that technical difficulties in the preparation of blood plasma for air-raid purposes have been overcome. Equipment is being manufactured locally and what is wanted now is a good response from the public to blood donor services in the Provinces and Indian States.

In a number of centres in India blood plasma is already being prepared. Dry blood plasma manufactured abroad is also being supplied to India.

The manufacture of dry blood plasma requires an elaborate unit which has recently been perfected in the United Kingdom and the U. S. A. Two dry blood plasma plants are on order from abroad and an experimental one is under construction in India.

## Public Health Section

### PUBLIC HEALTH ORGANIZATION

#### II. ORGANIZATION OF A MATERNAL AND CHILD HEALTH DEPARTMENT

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IN the introductory article in this series, attention was called to the important rôle of the maternal and child health services in the general scheme of work of the health department. These services occupy in fact a key position.

In India almost 50 per cent of the total annual deaths occur amongst mothers during pregnancy and childbirth and amongst infants and pre-school children. Deaths are merely a measurable index of health, and the state of health in a community where so many deaths occur, and in the school-going and adult populations arising out of the community cannot but be a matter of grave concern to every health department whose objective is a healthy population. The most effective, and in the long run economical, way of reducing deaths and improving the national health is to concentrate the attack where the incidence of sickness and death is greatest, and in India that is during pregnancy, infancy and early childhood. A further reason for beginning the health campaign at this stage is that much of the work now done by health departments rests on an unsound basis. Epidemic and environmental control measures cannot produce the maximum potential benefit in a population physically unfit. But there is yet a more fundamental reason for establishing a maternal and child health department. The maintenance of health and the prevention of disease are personal matters and depend on the intelligent co-operation of the individual. Intelligent co-operation can only be secured by education, by getting across to the individual an understanding of the scientific principles on which health is based, and by persuading him to apply these principles to his daily life and to use all the services provided by the medical and health and other social departments which will help him to this end.

The most educable section of the community is the school population but because the health of the school child may already be impaired beyond complete recovery by parental ignorance and mismanagement the care must begin at an earlier stage by the concurrent education of the parents in the upbringing of their children. The best agent we know for this purpose is the public health nurse or health visitor, and because parents will often do for their children what they will not do for themselves the most effective method of gaining entry into the home, of making contacts and influencing the life of the family is a visit to a new-born baby.

Contact can also be made through the delivery service. Assistance at childbirth is something which the people understand and want, and confidence engendered by this means prepares the way for the building up of many other public health services for the control of tuberculosis, leprosy, venereal disease, domestic and environmental hygiene. The child cannot remain healthy if malaria or fly breeding is prevalent, if attention is not paid to nutrition and horticulture, if housing, domestic and community refuse disposal are bad, if milk and water supplies are infected and unless social, economic and family relationship problems are tackled. All these matters therefore come within the purview of the health visitor attached to the maternal and child health department. The maternal and child health services in fact touch on and influence every activity of the health department, hence their basic importance.

A multitude of nutritional defects and common disorders of the respiratory and digestive systems, blindness, deafness and other defects and diseases which crowd the dispensaries and hospital out-patients, have their origin in infancy and childhood and can only be controlled by educating the parents in the care of their children. School and adult health are of importance in education, industry and society. The maternal and child health services are one of the main contributory channels through which the work of all these departments can be facilitated and improved.

The question which has now to be considered is, what machinery is necessary for the effective carrying out of this education for life and health? The first essentials are the establishment of a maternal and child health section in the public health department and the appointment of a full-time medical officer to organize and direct the work. To some this may sound like putting the cart before the horse. If there are no services and no staff to direct, what is the use of a director? The answer is that where there is no agency to focus attention on the need for maternal and child health, to enlighten local authorities and stimulate them to establish schemes the work will either not develop or, if developed, the chances are that it will be haphazard, limited, inco-ordinated and unrelated to the most urgent needs of the community. Planning is essential and to be effective the planning must be intelligent, that is, it must be based on knowledge. The first duty of the maternal and child health department therefore is to collate all the available data regarding relevant vital statistics and the facilities and staff provided for pre-natal care, institutional and domiciliary midwifery, infant and child care including the hospital services for sick children, the various ancillary services such as crèches,

nursery schools, orphanages; the existing legislation and the facilities for training the necessary staff of doctors, health visitors and midwives. The data will provide an indication of the *extent* of the problem and the provision made but it will have to be supplemented by an evaluation of the *quality* of the services and this can only be done by personal investigation in the field. A detailed survey of a whole province on these lines is not a feasible proposition. A limited and superficial survey of selected areas can, however, provide sufficient basis for the formulation of principles and for the setting up of experimental schemes.

Several types of scheme must be tried out to suit varying local conditions, local and individual financial resources, the local facilities and staff available and special health problems. In urban areas a fairly complete scheme for maternal and child health should be possible; in the village in the first instance it may be possible to do nothing more than to train the local *dai* to recognize abnormalities in the pre-natal period and to teach her asepsis and non-interference. A further step would be to teach her the elementary principles of malaria or hookworm control if these are the most serious problems or to carry out an 'eat unpolished rice' or 'boil your water' campaign if this seems the most effective means of reducing sickness and deaths. The schemes may be carried out by local authorities, by voluntary agencies or by the combined effort of both.

Good work is never static and the maternal and child health department will find never-ending occupation in analysing and drawing deductions from statistical data, in studying the defects, failures and successes of the experimental schemes, in evaluating the quality and quantity of the work, in planning extensions and developments and in revising the training of the staff in the light of experience.

As soon as a policy has been formulated the next duty of the department is to translate it into action. To effect this, much propaganda work will have to be done amongst the general population and more particularly amongst local authorities and voluntary organizations who are responsible for or interested in health, and amongst the medical profession, whose interest and co-operation must be secured. Conferences may have to be held and post-graduate courses arranged for the doctors taking part in the scheme. The establishment of a technical advisory committee is a useful means of maintaining the support of the medical profession and of voluntary organizations while at the same time providing the local authorities with skilled advice. One of the most effective forms of propaganda is the demonstration of an actual piece of work, and at least one urban and one rural model unit should be established in each province to be used for the practical training of the staff of doctors, public health nurses, midwives and other workers and for the

enlightenment of local administrators and voluntary workers. A demonstration unit is also extremely valuable for research work and experimentation with new methods.

Local authorities have *power* to provide for maternal and child health services and when public health acts become universal provision may become a statutory obligation, but even this will be insufficient to secure development along sound lines. If the services are to be of a high standard and basically more or less uniform, central control is desirable. Control can be exercised by requiring local schemes to be submitted for approval to the maternal and child health department before any expenditure is incurred and by supervising and advising on the work after it is undertaken. But local resources are small and if headway is to be made the advice of the department must be backed up by grants-in-aid from the central revenues. The administration of these grants will be a function of the maternal and child health department.

Other functions of the department are indicated in the diagram on the next page.

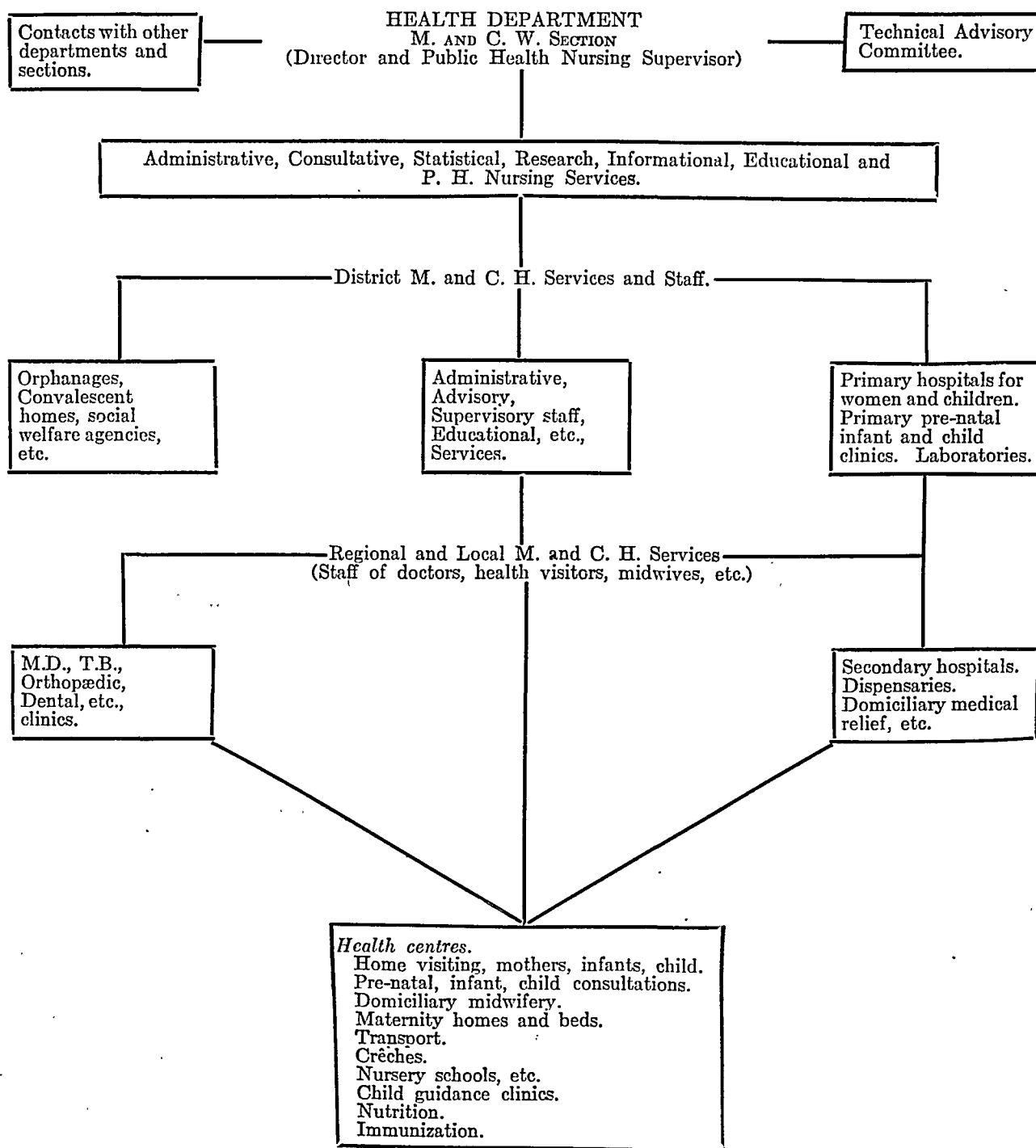
As the work develops additional administrative medical officers one to each district will be required for the adequate supervision and direction of the district maternal and child health services. These officers require to have special technical qualifications, high administrative and executive ability and a sound comprehension and experience of the work. To ensure the appointment of competent officers good conditions of service, security of tenure and opportunities for post-graduate study, these officers should be on the cadre of the provincial government. The functions of these officers are similar to those of the director.

In the maternal and child health field the divorce of curative and preventive medicine is disastrous. The expectant mother cannot be under one service while well and another if she develops any abnormality. Continuity of care is lost if her pre-natal care is given by one staff and for her confinement she enters an institution with which she had few if any contacts. The marasmic child who develops pneumonia cannot be under one service for instruction about feeding while another gives him medicine for his sickness, each in a water-tight compartment. Co-ordination between all the services must be secured and the district medical officer for maternal and child health should supervise not only the work done in and from health centres but preferably also in hospitals for women and children, in maternity homes, and by the domiciliary midwifery service, in fact all the health and medical services for women and children whether voluntary or official in the district. If unified control proves impracticable in the initial stages, close and harmonious contacts and co-operation between all the agencies and bodies concerned must be secured by the establishment of a district advisory committee representing all interests.

The district medical officer for maternal and child health should be responsible for planning, developing and supervising the district programme and for the proper co-ordination of all the services. It is not possible within the scope of this article to deal with the hospital, dispensary, maternity homes and health centre policy for a district. Further experimentation is necessary in this field before a definite policy can be laid down but the principle of planning on a regional basis is gaining wide acceptance as the soundest method of organization. In the maternal and child health field the smallest units, namely, welfare centres, women's dispensaries, the domiciliary medical and midwifery services,

maternity homes, anti-venereal and other special clinics, would be the individual or joint responsibility of one or more local health authorities according to the population and area; at a higher level and on a wider basis would come regional, general and maternity hospitals, and more elaborate health centres and laboratories; on a district basis well-equipped general and special hospitals and institutions; and at the centre the teaching hospitals, demonstration and research units and well-equipped laboratories.

The basic maternal and child health services to be provided by the local health authorities are: (1) Pre-natal—including home visiting, hospital and health centre clinics, pre-natal beds in





hospitals. (2) Natal—including institutional and domiciliary midwifery services. (3) Post-natal—including home visiting, infant, child and post-natal health clinics, hospital beds for sick children, crèches, and until these are taken over by the education department, nursery schools. The administrative details may vary from one locality to another. The consultation health clinics may be conducted by special full-time medical officers or staffed from a panel of general practitioners, or by buying the part-time services of obstetricians and pædiatricians from teaching or other hospitals. The actual organization is not so basically important as the technical qualifications, experience, ability and outlook of the officers employed. Apart from the medical officers who may be part time or full time, a full-time staff of midwives and health visitors is required and clerical assistance will be necessary in all but the smallest schemes.

The fundamental aim of the maternal and child health services is the education of the parents in the nature and nurture of their children and incidentally also for better citizenship and a fuller life. For reasons explained earlier the most vital factor in the attainment of the objective is the health visitor or public health nurse. The aspect of the maternal and child health services likely to have the greatest popular appeal is the delivery service, but it must be remembered that no matter how good this is it will fail to achieve success if the mother is not made physically fit beforehand, nor is it logical or economical to provide for the safe delivery of the infant if it is born in a debilitated condition or if it is allowed to die within the next few months or years from the accumulated effects of maternal mismanagement. The public health nurse is therefore an indispensable factor in the services, and an essential feature in the central maternal and child health department is a public health nursing section in charge of a director or supervisor of public health nurses and of midwives. District supervisors will become necessary as more health visitors and midwives are employed if the work is to be properly supervised, if the education of the staff in new techniques and for new duties is to be accomplished, and if conditions of service of the staff including freedom from exploitation are to be safeguarded and reasonable security of tenure of office secured.

A technical advisory committee at headquarters composed of qualified experts particularly in the field of obstetrics and pædiatrics, public health nursing and social work while not essential has considerable value. The medical profession is more likely to back any proposals known to be sponsored by leading technical experts. Further the expressed opinion of experts, viewing the services from a different angle and in the light of different experience, can be a valuable corrective to any tendency towards bias or narrowness of outlook, in the planning of policies, programmes and methods.

## BENGAL PUBLIC HEALTH REPORT FOR THE YEAR 1940. PUBLIC HEALTH DEPARTMENT, GOVERNMENT OF BENGAL

*Vital statistics.*—There were 1,681,846 births registered in the year as against 1,597,651 in the preceding year. The birth rate was 33.7 per mille being 5.3 per cent above the rate of 1939. There were 1,111,082 deaths as compared with 1,090,530 in the previous year, the death rate being 22.3 per mille and 1.8 per cent above that of the preceding year. Calcutta was the solitary district in which deaths exceeded births.

*Infantile and maternal mortality.*—The total number of infantile deaths was 267,894 compared to 234,301 in 1939. It represented 24.1 per cent of the total mortality in the province. The number of maternal deaths was 15,758 as against 15,792 in the preceding year.

Three new maternity and child welfare centres were opened; altogether 18 such centres functioned during the year under review. The Model Health Unit established by Government at Singur 1939 provided *inter alia* facilities for institutional service both for pre-natal care and midwifery services. The annual grant for the training of indigenous *dais* was distributed among the different local bodies and other organizations as usual.

*Cholera.*—A remarkable feature was that the mortality from cholera was the lowest on record during the past fifty years. There were 21,743 deaths from this disease with a death rate of 0.4 per mille as against 33,221 deaths in 1939 with a death rate of 0.7 per mille—a decrease of 34.0 per cent over the figures of 1939. The usual preventive measures were taken in combating this disease.

*Smallpox.*—The mortality from this disease showed a marked decline, the total number of deaths being 5,608 against 7,029 in the preceding year, with a death rate of 0.11 and 0.14 per mille respectively. The mortality thus fell by 20 and 64 per cent compared with the year 1939 and the previous quinquennium respectively.

The number of persons vaccinated in 1940 was 8,476,920 against 7,925,382 in 1939. The increase is a happy sign which might have been due to the greater attention paid by the local authorities in the matter of vaccination than in the previous years.

*Malaria.*—51.5 per cent of the total mortality from fevers was due to malaria, which again accounted for 33.3 per cent of the total provincial mortality during the year, the corresponding percentages in 1939 being 49.6 and 31.3 respectively. There were 369,448 deaths from malaria in 1940 against 341,321 in 1939, representing an increase of 8.2 per cent. The death rate correspondingly went up from 6.8 to 7.4 per mille in the year under report.

*Kala-azar.*—This disease was responsible for 15,453 deaths with a death rate of 0.31 per mille as against 17,056 and 0.34 respectively in 1939. The highest mortality from the disease was recorded in the rural areas of Dinajpur. The special anti-kala-azar scheme, inaugurated in the district of Darjeeling in December 1937, continued to work satisfactorily during the year under review.

*Special anti-malaria measures.*—The survey and control measures in connection with the campaign against *Anopheles ludlowii* were carried out satisfactorily in the Salt Lake area, Budge-Budge and the suburban areas with the co-operation of the Corporation of Calcutta and other local authorities and interests concerned.

The special anti-malaria scheme for the town of Jessore and its surrounding rural areas undertaken in the year 1939 was continued.

Special investigation was taken by the transfer of the field malaria research laboratory to Netrakona (Mymensingh) and also to Kalimpong, Darjeeling district, in order to find out the local vectors and to investigate the various aetiological factors responsible for the spread of malaria.

Two anti-malaria schemes, *viz.* the Gopalganj drainage scheme in the district of Malda and the Nadana Khal re-excavation scheme in the district of

Noakhali, were sanctioned by Government during the year and a grant equivalent to half of the total estimated cost of these two schemes was made by Government, the other half being met by the district boards concerned.

A malaria engineer was appointed by Government in the public health department to assist local bodies in drawing up and executing anti-malaria schemes of an engineering type.

*Pneumonia* accounted for 44,967 deaths against 47,888 in the preceding year, showing a reduction of 6.1 per cent.

*Pulmonary tuberculosis* took a toll of 12,363 lives against 12,422 in 1939, the death rates being the same in both the years, viz, 0.25 per mille.

A comprehensive scheme for the prevention and control of tuberculosis in the province, in co-operation with local bodies and voluntary organizations, was formulated.

The Bengal tuberculosis association rendered valuable service by publicity and propaganda work in the province with the usual grant from Government and maintained six dispensaries in Calcutta and one in Howrah. The association also organized post-graduate training courses on tuberculosis in Calcutta and assisted in the training of the students for the diploma of public health and the health officers deputed by the Government of Bengal.

*Enteric fever* was responsible for 7,875 deaths as against 8,290 in 1939.

*Influenza*.—There were 2,127 deaths from influenza compared to 2,467 in the preceding year.

*Cerebro-spinal fever* accounted for 1,378 deaths against 1,721 in 1939, showing a marked decline in mortality from the disease.

*Typhus fever*.—The number of deaths from this disease further increased from 4,443 in 1939 to 5,183 in

the year under report. Calcutta was, however, entirely immune from the disease.

*Dysentery and diarrhoea*.—These diseases respectively took a toll of 24,730 and 20,692 lives as against 27,301 and 27,152 in 1939.

*Leprosy*.—The number of recorded deaths from leprosy was 1,304 against 1,517 in 1939, representing a reduction of 14 per cent. The largest number of deaths occurred in the district of Bankura. With a view to ascertaining the incidence of leprosy and suggesting measures for the control of the disease, a number of sample leprosy surveys were carried out by the British Empire Leprosy Relief Association.

*Fairs and festivals*.—The usual medical and sanitary arrangements were made for the welfare of the pilgrims and the prevention of outbreaks of infectious diseases in the chief *melas* in the province. The St. John Ambulance Corps rendered valuable assistance at the Ganga Sagar *mela*. It is gratifying to observe that no deaths from either cholera or smallpox occurred at the *melas* during the year.

*School hygiene*.—During the year 10,844 boys in 41 schools in Calcutta, 8,863 students in 125 schools in 26 municipalities and 1,750 boys and 72 girls in 54 schools in the rural areas were medically examined. The sanitary inspectors in charge of the rural public health circles also examined 207,988 pupils in 5,800 schools in the rural areas.

*Health propaganda*.—A weekly public health bulletin was published throughout the year and posters, charts, models, etc., relating to public health propaganda were prepared and distributed as usual.

*Miscellaneous*.—The normal activities of the department were maintained and their scope was widened in certain respects. Grants-in-aid were made to the local bodies as usual in order to enable them to make provision for health welfare services.

## Current Topics

### New Rules for Asepsis

(From the *British Medical Journal*, Vol. II, 15th November, 1941, p. 698)

It has become abundantly clear in recent times that 'hospital infection' is by no means a thing of the past. It must always have existed, although remaining mostly unrecognized, in 'septic' wards, but it has now become a major problem in hospitals dealing extensively with casualties. The detailed study of wound flora, and in particular the typing of hæmolytic streptococci, have made it possible to trace the spread of infection from case to case; that this is a frequent occurrence and may involve considerable numbers of patients was shown by the investigations of A. A. Miles and others published in this journal last year. The burden of their argument was that the many precautions taken in the operating theatre do not always extend to ward work, where various faults in technique may cause avoidable wound infections. Few surgeons know everything that goes on in their wards, and many details connected with the sterilization of various materials and the care of wounds are left to the discretion of the nursing staff. It is with no disrespect to the nursing profession that some of their methods have been condemned, since they may reasonably ask that instructions for the proper conduct of such work should be made available; nor are they, in fact, by any means wholly responsible for the defects in technique which have been brought to light. There is need, in fact, for a thorough review of aseptic technique in the light of modern knowledge. So far as it concerns ward work, and as the direct outcome of recent research, this need has been met by the publication of *The Prevention of 'Hospital Infection' of Wounds*, a memorandum sponsored by the War Wounds Committee of the Medical Research

Council and the Committee of London Sector Pathologists. This furnishes in simple language, full instructions for the conduct of dressings, the sterilization of all ward apparatus and materials, and other precautions necessary to safeguard wounds from extraneous infection. It should be widely studied, and may well serve as the basis for generally accepted hospital rules or, indeed, be adopted *in toto* for that purpose.

The chief instructions for avoiding contamination by dust and by droplet infection are already widely observed. Apart from the oiling of floors, it is laid down that sweeping and bed-making should be finished an hour before dressings are begun, and that during the dressing itself bedclothes should be moved gently. Closed plasters are a prolific source of dangerously infected dust, and should be opened only in a special room. A pattern is given for a simple and effective mask, and masking of the staff and silence on the part of other patients are enjoined during the conduct of dressings. The method of doing dressings requires two people, and may be considered too elaborate for universal employment; on the other hand, it is carefully thought out, and every step has its reason. The operator is not required to 'scrub up', but merely to wash his hands; he works entirely with forceps, and should not touch the wound and the surrounding skin, the inner dressing, or any sterile material. It should be noted that this technique demands a generous supply of forceps and certain utensils; a shortage in this direction is the most easily remedied source of difficulty and consequently of danger. Some may wish to vary these instructions, but if so they will do well to bear in mind their underlying principle: that the hand should never touch either the wound or anything supposed to be sterile. The observation of this single rule would perhaps do more than anything else to prevent avoidable wound infections. It is also pointed out that

contamination of wounds may take place when they are handled by others than the ordinary surgical staff; precautions must therefore be taken when calling in the services of the radiologist, masseuse, or physio-therapist.

It is now notorious that infection has frequently been transmitted by utensils and other materials which are believed to have been sterilized but have not. Baths of various kinds have played a sinister part in this connection: a full-sized bath must be treated chemically, and rubbing over with strong lysol is recommended. Arm baths must, if necessary, be treated in the same way, but it is far better to boil them; another strong injunction given is that every ward should possess a sterilizer of such a size that it can contain all bowls, dishes, and other such utensils which require sterilization. Heat is preferable to chemical disinfection whenever it is feasible, and full instructions are given for the proper use of the autoclave; four alternative methods are offered for the sterilization of syringes by heat. There is nevertheless an appendix on chemical disinfectants, dealing only with the three principal types of coal-tar origin, with instructions for their specific uses, and the suggestion that some such instructions should be posted up in every ward. The intelligent co-operation of the nursing staff in all these matters can be secured by teaching them elementary bacteriology from this point of view, preferably with simple practical demonstrations. It is finally suggested that a large hospital needs a senior officer whose chief business it is to supervise the control of infection, both by teaching and by seeing that these rules continue to be observed. We commend this memorandum very strongly to surgical staffs, with the suggestion that they either adopt its rules or make better ones if they can.

## Pleural Effusions

### Their Causes, Diagnosis and Treatment

By R. ELLIS, M.D., M.R.C.P.

(From the *Medical Press and Circular*, Vol. CCV, 30th April, 1941, p. 356)

THE presence of fluid in the pleural cavity is always a cause for concern, if not actual anxiety, to the medical practitioner. The preceding history will often prove the correct guide to determining the nature of the effusion whether it be a transudate or an exudate.

Transudates, or passive effusions, are to be expected in the presence of heart failure, acute or chronic nephritis, intra-thoracic neoplasms, in the terminal stages of various debilitating diseases, and occasionally with suppuration below the diaphragm. Active effusions, or exudates, occur in the presence of acute inflammation. This may be in the lungs and pleura, as in pneumonia. The inflammation may spread to the thorax from without, as in subphrenic abscess and septicæmia, or the inflammation may be of a more generalized character as in acute rheumatism, though here the fluid is never purulent. Of chronic inflammatory lesions causing pleural effusion, tuberculosis is the one most commonly met with in this country.

#### PHYSICAL SIGNS OF PLEURAL EFFUSION

The characteristics of pleural effusion are the absence of tactile fremitus, wooden dullness on percussion, absent or diminished breath sounds, ægophony at the upper border of the fluid, and displacement of the apex beat of the heart. In the early stage, or in 'dry' pleurisy, a friction rub may be the only sign. With a moderate or large effusion the affected side of the chest appears to be flattened in full inspiration, whilst in expiration it appears to bulge.

The dullness is partly due to the fluid and partly to the compression of the lung. It is found earliest at the base posteriorly and may reach as high as the clavicle, and include or extend beyond the sternum. On the right it merges imperceptibly into the liver dullness.

On the left Traube's semilunar area of resonance is rarely obliterated except by very large effusions. Moveable dullness occurs only with pneumothorax. Ellis's S-shaped line, Grocco's triangle of paravertebral dullness, and Litten's diaphragm sign can also be demonstrated. A valuable sign is displacement of the heart towards the opposite side. In neoplasm of the lung and collapse of the lung without effusion the heart is drawn to the side of the lesion. Skodaic resonance is usually quoted as a sign of effusion, but it occurs also with pneumonia, though to a less marked degree.

Auscultation in the early stage of pleurisy reveals a friction rub, usually of a creaking or leathery type, occurring both with inspiration and expiration. It is unaffected by coughing, but disappears as effusion develops. Occasionally fine crepitations can be heard, as in pneumonia.

With effusion the breath sounds become weak or absent over the dull area. In children especially they may be bronchial in type. Above the dull area the sounds are harsh, loud and often tubular, and may be associated with râles.

Vocal resonance is usually absent or diminished.

Ægophony, the nasal twang or goat-like bleating of the transmitted voice sounds, is quite commonly heard at the upper level of dullness or at the angle of the scapula. The diminution of the breath sounds is not due to the fluid as such, but depends on compression of the bronchi, fluid being a good conductor of sound.

Radiography is often helpful as an aid to diagnosis, but it is as reliable in demonstrating the presence of fluid as in so many other pulmonary conditions. For instance, thickened pleura will give a shadow very like that of a thin layer of fluid.

Having decided, on the history and physical signs, that fluid is present, it is usually safe to explore the chest, though it is not always necessary to aspirate any great quantity immediately. The treatment to be adopted depends on the nature of the fluid, which may be clear or turbid, purulent, hæmorrhagic or opalescent. Hæmorrhagic effusions (not to be confused with hæmo-thorax) occur in tuberculosis, from the rupture of newly formed vessels in the inflamed pleura; in neoplasms of the lung, which is the commonest cause; and very rarely in association with chronic nephritis, cirrhosis of the liver and severe fevers. Any effusion which has been aspirated recently may be blood-stained from the rupture of vessels, either by the aspirating needle or as a result of too vigorous aspiration. When trauma results from introducing the needle, only the first sample of fluid will be heavily blood-stained and the amount of blood will decrease as the aspiration proceeds. Should a grossly enlarged *left* auricle be mistaken for an effusion in the *right* pleural sac and exploration or aspiration be attempted, then pure blood will be withdrawn easily, in contra-distinction to the difficulty experienced when the needle enters lung and a little bloody fluid is obtained.

Opalescent exudates are found most frequently in nephritis. Sometimes they are found in association with neoplasms, or after repeated aspiration. The lipid which causes the opalescence is soluble in alcohol but not in ether. Such fluids are therefore pseudochylous. True chylous fluid is very rare, occurring only with lesions of the thoracic duct or infections with filaria. Pneumococcal fluids, at the time of exploration, are usually creamy pus, containing much fibrin, though clear, or only faintly turbid fluid containing pneumococci and a few polymorphonuclear leucocytes may be found earlier. Fætid fluids are most likely to be found where there is a communication between a bronchus and the pleura, in bronchiectasis, gangrene of the lung and with infections of the colon group of organisms.

*Cytology.*—Unless one is very sure of the underlying pathology it is advisable to examine any fluid obtained on exploration. Small lymphocytes will be the prevailing cells in chronic inflammatory lesions. These are almost always tuberculous, and the fluid is sterile. Tubercle bacilli are rarely found. To prove the nature of the infection it is necessary to resort to animal inoculation.

Polymorphonuclear leucocytes will be found in acute infections with pyogenic organisms.

Endothelial cells are principally found in transudates, especially those due to neoplasms, when the cells may show mitosis. In transudates it frequently happens that there are no cells to be found.

**Bacteriology.**—Almost any pyogenic organism may be found in purulent exudates. The commonest is the pneumococcus and with it the prognosis is usually good. The next in order of frequency are the streptococci. Here the prognosis is less favourable, and the condition requires more careful handling. Staphylococci and other pyogenic organisms are less frequent causes of pleural exudates. Tubercle bacilli, although a common cause of pleural effusions, are rarely found in the fluid, whether it be serous or thick and caseous. Organisms are rarely found in serous effusions, except in the early stages of fluids which eventually become purulent.

**Course.**—The course of pleural effusions is variable, though on the whole they tend to be absorbed provided the effusion is not so large as to compress vessels. Absorption is fairly rapid in those cases of pleurisy following a 'chill', and in the so-called idiopathic types. The fever subsides by lysis in about seven to ten days, and the fluid level begins to decrease steadily after this. The actual time for absorption will depend on the amount of fluid present. With large effusions extending above the level of the fourth rib in front absorption is slow until some of the fluid is aspirated. Tuberculous effusions tend to persist unchanged for long periods. When an effusion recurs after aspiration it is probable that there is a neoplasm of the lung or pleura. With permanently collapsed or carnified lung, with tight adhesions or persistent pleural irritation, an effusion is likely to persist or recur after repeated aspiration. Two factors suggesting persistent effusion are densely thickened pleura and collapsed lung.

The earliest sign that absorption is taking place is the reduction in the degree of displacement of the heart. Later there is a return of breath sounds and tactile fremitus. It rarely happens that there is a return of a friction rub since adhesions form too quickly. When absorption is unusually rapid the chest wall falls in, returning only slowly or incompletely to the normal position owing to adhesions.

**Treatment.**—Treatment will depend on the cause of the effusion and its nature. Therefore, the preliminary to treatment is to withdraw a sample of the fluid for inspection. For this a 10 c.c. or 20 c.c. syringe is necessary, together with a needle suited to the development of the patient. In children and those with a thin chest wall a medium-bore hypodermic needle will suffice, otherwise a serum needle will be required. Should there be reason to suspect pus, a larger bore needle will be necessary if the exploration is to be successful. The use of the local anæsthetic is optional, but when a thick needle is used then an anæsthetic is preferable. The usual site for exploring is in the eighth or ninth interspace in the line of the inferior angle of the scapula though if the physical signs point to a loculated effusion the site will be determined by the position of the fluid. It is not advisable to withdraw the piston of the syringe until one is sure that the thickness of the chest wall has been penetrated, or blood may be obtained. An inter-lobe effusion may be reached by instructing the patient to place the hand of the affected side on the opposite shoulder. Then follow the line of the vertebral edge of the scapula to the axilla and explore in the eighth or ninth space in the mid-axillary line. This only applies to the space between the upper and lower lobes, not to the right middle lobe. Having found fluid, do not aspirate more than one syringe full with this apparatus or air will enter the pleural cavity. This may not be very important with a simple serous effusion, but should the fluid already be infected there is grave risk of a widespread empyema with unfortunate results.

**Indications for aspiration.**—Briefly, these are:—

Fluid large in amount (above the 4th rib in front).

Fluid increasing.

Embarrassment of respiration or pulse.

Fluid not absorbing after at least two weeks.  
Fluid infected or already purulent.

Having decided that aspiration is necessary, the procedure is similar to that for exploration except that a local anæsthetic is essential. First infiltrate the skin freely, then inject all the tissues down to, and including, the pleura. If a really large bore needle is to be used, its passage will be greatly facilitated by first making a small incision through the skin. Whatever apparatus is used for aspiration, the fluid should be withdrawn slowly. There are several instruments available for the purpose. Large capacity syringes with two-way taps have the disadvantage of high resistance between the piston and barrel wall, and the effort necessary to pull out the piston often leads to displacement of the needle, either from the syringe itself or in the chest wall. There is still much to be said in favour of the old-established Potain's aspirator with its flexible rubber connections and locking joints. Care must be taken to be sure that the pump has lowered the pressure in the suction bottle and not raised it. Burrell's bottle is perhaps the simplest and easiest aspirator to use since it has no moving parts to wear and the fluid cannot be withdrawn rapidly. However, the apparatus is one for personal choice. The operation must be carried out with the strictest regard to asepsis, and should be stopped if the aspiration causes much coughing, distress or signs of collapse. At the conclusion the needle track should be obliterated as far as possible by gently squeezing up the skin and moving the superficial tissues in several directions. Finally, seal the puncture with a collodion dressing. Where it is necessary to remove several pints of sterile fluid, air should be admitted, as in filling a pneumothorax, to replace the fluid withdrawn. Only in this way can a large volume be removed without causing serious discomfort to the patient or shifting the heart and mediastinum too rapidly. Since most serous effusions tend to be absorbed, it is rarely necessary to aspirate large quantities of fluid except as an aid to diagnosis, as, for example, in suspected bronchial or mediastinal neoplasm. In such circumstances the fluid obscures the main picture on x-ray examination. Not until the bulk of the fluid has been aspirated and replaced with air can a useful x-ray picture be taken.

Tuberculous effusions are best left alone unless by their bulk they are causing mechanical difficulties.

Transudates, as in congestive heart failure and nephritis, will only need aspiration when the effusion is large and a satisfactory diuresis cannot be obtained by the usual therapeutic measures. The effusions associated with pulmonary neoplasms often call for repeated aspiration since they are usually large, recur rapidly, and tend to cause mechanical embarrassment of the heart and opposite lung.

**Empyema.**—Aspiration in empyema is frequently an aid to recovery. In streptococcal empyema repeated aspiration is necessary before undertaking rib resection, since the pus is poor in fibrin and the cavity does not become shut off from the main pleura until the pus thickens. Open drainage before this takes place would result in pyo-pneumothorax with chronic empyema and an inexpandable lung bound down with dense layers of fibrin. Pneumococcal empyema is never made worse by aspiration. Rather the reverse, for it tends to reduce the ultimate size of the cavity. Occasionally repeated aspiration is the only treatment necessary. Of recent years there has been a tendency to treat empyema by continuous aspiration. In selected cases the results are excellent. At the worst, it will tide a very ill patient over the severe stages of toxæmia and allow a more radical operation to be performed later without risk. Sulphapyridine (M.&B. 693) will not prevent empyema, neither, in my experience, will it cure it. Great care should be taken in giving more of this potent drug to a patient who has already had the full course for his pneumonia. The risk of damage to the blood-forming tissues cannot be too strongly stressed.

Tuberculous empyema should always be treated by aspiration; never by open drainage.

*After treatment.*—Subsequent to aspiration or other form of drainage, whether the effusion be serous or purulent, the lung should be assisted to expand by breathing exercises. Patients who are too feeble to perform such exercises early in convalescence may be given frequent inhalations of carbon dioxide with oxygen for a few minutes at a time. This acts through the respiratory centre, causing full excursions of the diaphragm and chest wall. Later, blow bottles may be used and, finally, exercises in the gymnasium.

All cases in which the prevailing cell in the fluid is the small lymphocyte should be regarded as tuberculous and given the benefit of sanatorium treatment. Where there is no positive evidence of disease in the lungs, as shown by x-ray, the prognosis is good. Without sanatorium treatment, the prognosis is only fair or sometimes even bad.

### Eye Injuries in Warfare

By L. H. SAVIN, M.D., M.S., M.R.C.P., F.R.C.S.

(From the *Medical Press and Circular*, Vol. CCIV, 16th October, 1940, p. 298)

THIS article is mainly based on observation of a series of ophthalmic war injuries treated at Horton Hospital. Although the incidence of various types of injury may probably alter with variable war conditions, general principles of treatment are not likely to change radically—in fact, they have been applied for years in peace time to industrial eye injuries.

Eye injuries seen have been mostly lacerations, injuries by small foreign bodies and missiles, contusion injuries by blunt objects and explosive blast, and burns. Sequelæ of injuries, such as contracted sockets, cicatricial ectropion and entropion, and symblepharon, are beginning to appear. Ophthalmic injuries from war gases have not yet been seen at Horton, nor, fortunately, have we yet had cases of sympathetic ophthalmia.

Lacerations have been chiefly of lids. There seems to be a tendency among general surgeons to treat these injuries too drastically. Blood supply in the lids is so good that the extensive wound excisions necessary elsewhere in the body are not necessary there. Lid lacerations can be cleaned up and resutured without sacrifice of injured tissue, and there will seldom be sloughing. It is important that the lid margins shall be sewn in proper alignment, as irregularities greatly distress a sensitive patient. 'To think that this should happen to the best-looking corporal in the regiment', as one patient sadly remarked. The fact that he was badly smashed up in many other parts of the body did not seem to worry him.

In suturing together lid margins care must also be taken that the lashes are not allowed to turn in towards the globe. One of our patients had had a cut at right angles to the lid margin, and suturing had been roughly performed so that the lashes rubbed the cornea over a length of about 3 mm. Electrolysis was not practicable, as too many lashes were involved, but the condition was readily rectified by a plastic operation. The lid was first split longitudinally by an incision along the inter-marginal grey line of the lid-edge. A wedge-shaped piece was excised from the anterior flap, the affected lashes being along the base of the wedge. A similar-shaped wedge of the tissue was excised from the posterior flap of lid farther along, so that the two wedges did not coincide antero-posteriorly. The lid was reconstructed by resuturing in layers. The trichiasis was rectified and there was no visible deformity.

Particular care must be taken if the laceration involves the inner end of the lower lid where it may involve the lower canaliculus. If this is faultily resutured the patient may have a permanently watering eye. If seen early, the condition is easily treated. A fine silk suture is used with a needle on each end. One needle is passed down the lumen of the lateral cut

half of the canaliculus, coming out through the punctum lacrimale. The other needle is made to enter the medial cut end of the canaliculus. After passing a little way along the lumen it is made to turn forward so that the point is brought out on the skin of the face. By tightening the suture the two cut ends of the canaliculus can be brought into apposition. Union readily occurs.

The greatest care should be taken to avoid adhesions of lacerated lids to the globe, as troublesome symblepharon may be caused. If the adhesion occupies the lid margin only, simple division of the adhesion and subsequent separation of the cut edges may suffice. The condition is not so simple if the adhesion obliterates the conjunctival fornix. Here it will infallibly reform if simple division is resorted to. In one case of such symblepharon posterius the soldier was completely incapacitated by diplopia from limitation of movement of the globe by the adhesion.

The surgical prognosis in such cases has been greatly improved by the plastic operation invented by Duverger and Velter. The principle of the operation avoids the division of the adhesion. The adherent portion of the lid is cut away from the rest of the lid and left in undisturbed adhesion to the globe. The lid is first split along the inter-marginal grey line opposite the adhesion. With scissors the adherent portion of the posterior flap is cut around, so that the lid is completely separated from the globe. A new lid is fashioned anteriorly by the sliding flap method. The raw surface on the globe is covered by pedunculated interdigitating conjunctival flaps swung down from above the globe.

In modern warfare actual lacerations of the globe usually are sufficiently serious to necessitate enucleation. A few eyes may be saved by covering the lacerations by conjunctival flaps; but this is, unfortunately, exceptional. Any prolapsed ocular tissues, such as iris, choroid, or ciliary body, should be excised. A prolapse replaced might form the start of an intra-ocular infection.

Enucleation of a badly lacerated eye may be a particularly difficult operation to carry out neatly. At Horton we have seen several badly contracted sockets from rough or infected enucleations. Inexperienced surgeons often get themselves into unnecessary difficulties in the enucleation of a perforated eye by omitting to sew up the perforation at the first stage of the operation. If this is done it is usually possible to enucleate the eye in the classical style as an operation deliberately performed in proper sequence of stages. Otherwise the operation is apt to resolve itself to much blind cutting with scissors in a mass of bleeding tissues. If an eye has collapsed like a squashed grape, identification of such structures as muscle, etc., becomes exceptionally difficult. It is better to hand on such an enucleation to an experienced ophthalmic surgeon rather than to rush the job at the casualty clearing hospital or advanced base.

Many injured eyes seem to be precipitately enucleated for fear of the possible destruction of the second eye by sympathetic ophthalmia. This, if it occurs, is a terrible tragedy, and it is much better to sacrifice a badly injured eye rather than incur the danger. There is, however, no usual necessity to make the decision immediately. An injured eye can usually be safely left for 14 days without incurring the risk of sympathetic ophthalmia. It will usually be possible to refer the patient during this comparatively safe period to a trained ophthalmic surgeon. Such a person will be less likely to obtain a contracted socket if he decides that an enucleation is necessary.

Rough enucleation is not the only cause of a contracted socket. Another cause is prolonged sepsis, particularly sepsis involving the accessory nasal sinuses or the bony orbital margin. While sepsis is present, something can be done to prevent contraction of the socket by separating adhesions and by the use of a glass 'shell' to prevent the in-turned lashes from irritating the socket. Operative treatment must usually await the disappearance of the sepsis. In cases of



accessory sinus or bony involvement, the early co-operation of a rhinologist is desirable.

The operative treatment of a contracted socket varies according to the degree.

In some of the minor degrees a specially made artificial eye may sometimes be fitted after the division of one or more band-like adhesions in the socket.

In the next stage of severity the socket appears roomy and capacious; but there is a poorly defined lower conjunctival fornix. The artificial eye looks for a few moments as if it will stay in position; but it is then extruded, the lower edge over-riding the lower lid margin. To keep the prosthesis in position, a new lower fornix must be constructed. Most surgeons have their own favourite operations for this purpose. One successful method is to employ small mattress sutures of fascialate from the ilio-tibial band. By means of these sutures the lower sulcus of the socket is sewn into apposition with the lower lid, the free ends of the sutures being brought out on the skin surface. Fascial sutures need never be removed. The groove of the fornix is permanent, and the artificial eye stays readily in position.

In the most severe grades of contracted socket it is impossible to insert a prosthesis. For these cases the operation of Esser or one of its modifications can be employed. All the mucous membrane of the contracted socket is excised. A stent mould of the future socket is wrapped round with a large skin graft and buried in a bed cut in the soft tissues. The lids are sewn together over the mould, which is not removed until the skin graft is firmly attached to the new bed.

A large proportion of war injuries are inflicted by large and small flying foreign bodies. Many such injuries will be obviated when the Cruise visor is generally adopted.

The skin of the lids is frequently tattooed by flying carbon particles. These carbon particles require no treatment and are gradually extruded from the skin surface. Similar carbon particles are often found on the cornea. They can readily be removed with a sharp dissection needle from the cocaineized cornea.

From bursting bombs most of the injuries seem to be due to tiny flying fragments of white metal. Analysis of some of the pieces has shown the metal to be an alloy containing aluminium and magnesium. After a few days' exposure to the ocular fluids the metal is crusted over with a white crumbly powder.

Such fragments can easily be picked out from the cornea with a sharp dissection needle. This was found possible even in one case where the tip of a small metallic flake was protruding into the anterior chamber. The flake was soft metal, which was impaled on the dissection needle and withdrawn. A gush of aqueous followed from the corneal perforation.

Surprising momentum is imparted to such fragments by a bomb explosion. We have often been surprised to note the distance penetrated by pieces so small as to require a slit-lamp for their inspection. In one case a piece of very small size passed completely through the cornea and the crystalline lens, its tip entering the retro-lental space. The patient's other eye had completely lost its sight. Like most of the bomb fragments, this particular piece of metal was non-magnetic. Active surgical intervention seemed out of the question, and the patient was simply kept under observation. A localized opacity formed around the track of the fragment through the lens. The piece itself gradually became covered with a crumbly, powdery coat, presumably of hydroxide. Polychromatic lustre made its appearance on the posterior lens capsule. So far the deterioration of vision is only what would be accounted for by the localized lens opacity. Another patient had the vitreous filled with shining metallic fragments, looking very similar to a synchysis scintillans.

Larger pieces of metal, such as shrapnel, usually destroy the eyes they hit. In certain instances, however, the pieces have passed close to the eye without penetration. In such instances the eye frequently sustains a concussion injury. The anterior chamber is

filled with blood which later clears, allowing a view of the interior of the eye. In most of these cases there is some serious internal injury, such as a detached retina or ruptured choroid.

There have been a large number of injuries by blunt objects or by blast. In two cases the optic nerve has been ruptured by a blow on the outer side of the orbit. In these cases vision is lost immediately after the blow. The pupil of the affected side loses its direct light reflex, though the consensual contraction to light on the other eye is retained, as also the reaction to accommodation. Later on the affected disc becomes atrophic.

The sixth nerve is often paralyzed after contusion injuries. Many of these paralyses are temporary in nature, so that it is worth waiting for some months before seeking remedies by surgery. The operation of choice is that of Temple Smith, in which the action of the external rectus is taken over by slips of muscle transplanted from the superior and inferior recti. A recession of the internal rectus is undertaken at the same time.

The superior oblique is often affected by injuries involving the trochlea. In these cases much relief from the troublesome diplopia can be obtained by a recession of the superior rectus of the same eye.

The eye is often injured by blast. In several of these cases a Vossius ring has been visible, a dark imprint of the pupillary outline on the anterior lens capsule. These rings slowly disappear. It is not infrequent for the crystalline lens to be dislocated or partially subluxated. In one case the patient had monocular diplopia, as he had one image through the aphakic part of the pupil, another through the lens. The sclera has been several times ruptured by blast, usually but not invariably subconjunctivally. Lens, iris, ciliary body, choroid or vitreous may be seen forced out through the rupture. The choroid is frequently ruptured or detached. In the cases where the retina has been detached by blast injury, there have been too many tears in it to render surgical interference practicable. In two cases retinae have been detached by ordinary strains and stresses. In one case a myopic soldier gave his rifle a sharp upward cant when he saw a bright flash in his left eye. He had a large detachment with an obvious disinsertion, which was easily closed by operation. Another man detached his retina when he flung himself quickly down on the ground to take cover. He had three small round holes, which corresponded in the detached retina to old patches of choroidal scarring. The retina was replaced by operation.

Electric and thermal burns have been fairly common. Those seen in the first instance have not been particularly severe in character, and have been simply treated by antiseptics. The areas involved have not been large enough for the tannic acid treatment to seem necessary. There have been several cases of cicatricial ectropion after burns. These have been treated by performing a tarsorrhaphy after dissecting out the contracted scar tissue: the raw area has been covered by a whole-thickness Wolff skin-graft, usually taken from the hairless skin behind the ear. These Wolff grafts take readily and have the advantage that they do not contract after transplantation. Later on the tarsorrhaphy is undone.

So far we have seen no ocular injuries from the war gases, and only one case in which a piece of shrapnel injured the higher visual centre in the occipital lobe.

It will be seen that most of the eye injuries of war time are similar to the ordinary peace time industrial eye injuries.

### Pleurisy

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(From the *Practitioner*, Vol. CXLVI, April 1941, p. 223)

THE treatment of pleurisy can be considered under two headings, the immediate treatment of the presenting symptoms, and treatment of the underlying lung



condition. From the point of view of the patient palliative treatment is perhaps the more important of the two, for pain is the most common symptom and the relief of pain is the most pressing need in acute cases. The cause of the pleurisy is of more remote importance, as the view taken concerning the aetiology of the condition to a large extent determines the advice which must be given concerning convalescence and after-care.

#### ACUTE PLEURISY

Acute pleurisy is nearly always of the fibrinous type, and many cases do not progress beyond this stage. When 'primary', it is commonly due to tuberculosis, and the underlying lung may be affected to a greater or less extent. In some cases the disease appears to be entirely confined to the pleura, whereas in others an acute pleurisy may be merely an event in the course of established pulmonary tuberculosis. In all cases in which acute pleurisy appears to be 'primary' it is as well to assume that the cause is tuberculosis unless definite proof of some other cause is forthcoming.

The chief symptom of dry pleurisy is *pain* in the chest, worse on inspiration, and often attended by a dry cough which increases the pain. It follows that in the treatment of dry pleurisy the most important measures to be adopted will be those designed for the relief of pain and cough. The patient will naturally be in bed and will adopt the position of least discomfort. In many cases he lies on the affected side in order to minimize respiratory movement, and this object can be assisted by strapping the affected side of the chest. For this purpose it is necessary to obtain wide strips of elastoplast, or other strapping, which should be applied firmly from below upwards with at least half an inch of overlap. Strapping the chest contributes greatly to the comfort of the patient, but the removal of the plaster may be so unpleasant as almost to counteract its advantages, especially if there is much hair on the chest; the best way to remove strapping is to wipe it off gently with antihæsin on cotton-wool, being careful not to attempt to hurry the procedure.

When there is extensive change in the lung substance, as occurs with lobar pneumonia, it is unwise to strap the chest and other measures must be employed for the relief of pain.

Of these, the most usual method is to apply a poultice to the chest, the favourite at the present-day being a kaolin compound, although it is doubtful if this retains the heat as well as the old-fashioned linseed poultice. Kaolin is also apt to leave the surface of the skin sticky and it is inconvenient when the chest has to be examined. It is simple to prepare and to apply, however—hence its popularity. If a poultice fails to relieve the pain it may be necessary to employ some form of counter-irritant. A mustard plaster is a simple and fairly effective remedy, and blisters and leeches have their uses in the more severe cases. Should the pain still fail to respond, it may be justifiable to introduce 300 or 400 c.cm. of air into the pleural cavity, a method of treatment which is most effective and almost devoid of risk; the pneumothorax thus obtained is kept up for as long as may be desired, but it is usually safe to abandon it in the course of a week or ten days, except in cases in which the pleurisy is due to tuberculosis, in which event it may be kept going on standard lines as a method of treatment of the underlying lung condition.

Drugs, with the exception of morphine, are not of great value in the treatment of acute pleural pain, and it is better to trust to the measures already outlined. The usual course of the illness is one of fairly rapid subsidence of symptoms, and the chief question is then one of convalescence. An apparent primary dry pleurisy, for which no cause can be found, either on examination of the chest or on the x-ray film, should not be dismissed as a minor complaint. The ideal advice is that the patient should have at least three months' convalescence in the country. He should subsequently be kept under observation at gradually increasing intervals for two or three years, and serial

x-rays should be taken in order to keep a check on any subsequent development in the lung. Sometimes, for economic reasons it is not possible to carry out this programme in full, but a convalescence which falls short of this is incomplete, and an even more careful watch must be kept in order to forestall subsequent developments. Cough is rarely a troublesome symptom and it is usually sufficient to prescribe Gee's linctus. A more severe cough might be treated with heroin.

#### CHRONIC PLEURISY

Chronic dry pleurisy is a somewhat unusual condition and may be the result of a previous acute attack, or it may be detected in the absence of any history of acute pleurisy. In the former case it is likely to be tuberculous, and it is then due to recurrence of sub-acute inflammation in a pleura which is to some extent adherent. It may be due to tuberculosis, even when it appears as a chronic condition from the onset, but in such cases it may also be due to nodules of malignant growth in the pleura. It is therefore most important to investigate such cases carefully before forming an opinion. It is noteworthy that in some cases of malignant disease the pleurisy may be so gross that friction can be felt, and yet the patient may not complain of pain. A symptomless chronic pleurisy of this sort does not need symptomatic treatment and, if the cause be irremediable, there may be no treatment at all. In chronic pleural tuberculosis, if there be evidence that the disease is active, general treatment on the usual lines should be advised. Sometimes, however, pain may be intense and this applies particularly to a case in which growth involves intercostal nerves. It is quite likely that the measures suggested for acute pleurisy will not succeed in some of these cases, and it may then be necessary to inject a 1 per cent solution of novocain into the affected region of the pleura. A still more radical method of dealing with pain, especially when it is certain that it is due to involvement of intercostal nerves, is an alcohol injection to the nerves affected, together with the nerves immediately above and below. Good results are sometimes obtained by this method in cases of cancer of the lung and pleura.

#### PLEURAL EFFUSION

Pleural effusion may complicate a simple dry pleurisy or it may arise as an apparently primary event. In most cases the symptoms vary directly with the rate of accumulation of the fluid. A rapidly forming effusion may cause marked shortness of breath and an ache in the chest, whereas an effusion which has formed slowly, yet which completely fills the pleural cavity, may be detected on routine physical examination without any of the characteristic symptoms having been present. The detection of fluid in the pleura should be a comparatively simple matter. In the first instance it is noted that the affected side of the chest is moving poorly, or not at all, and inspection in a good light may show that the intercostal spaces on that side are not drawn in on inspiration (Litten's sign). On palpation it is found that the heart and trachea are shifted towards the sound side and the vocal vibrations are absent; the absence of vocal vibrations is a particularly important sign in the distinction between effusion and consolidation for, in the case of lobar pneumonia for instance, the vocal vibrations are often actually increased. On percussion the note is dull, and the shape of the dullness is of some diagnostic help. In a medium-sized effusion the upper border rises from the spine towards the axilla and then sinks as it approaches the sternum, whereas consolidation of a lower lobe gives an upper border which falls steadily from the spine of the scapula towards the lower part of the sternum. On auscultation breath sounds are not usually heard when an effusion is considerable, but this sign is often misleading and it is possible to hear bronchial breathing when there is a moderate amount of fluid present in the chest. Failure to recognize this fact is a not uncommon cause of failure to detect an empyema until it has already been present for some considerable time, but this mistake should not occur if

careful attention is paid to the other physical signs in the chest.

The *management* of pleural effusion depends to a large extent upon the cause. In this article it is proposed to deal entirely with clear effusions, and not to consider empyema as a complication of pleurisy. It may be accepted that most cases of primary pleural effusion, in young patients at least, are due to tuberculosis and every effort must be made to determine whether the damage is confined to the pleural membrane or whether the underlying lung is also diseased. The patient must be kept in bed until the temperature has been normal for at least a fortnight; this means that the duration of confinement to bed will be about six or eight weeks in the average case. While the patient is in bed a determined effort should be made to discover tubercle bacilli in the sputum, if available, or in the stomach washings. If the evidence points to absence of involvement of the lung it is usually sufficient to keep the patient in bed for the stated period of time, and further measures may not be necessary. It is, however, an excellent plan to withdraw some of the fluid for examination, bearing in mind that culture on Lowenstein's medium is a good method of detecting the presence of tubercle bacilli. A guinea-pig should be inoculated as a routine. There is another reason why a routine chest puncture should be performed, namely, that in this way a diagnosis is firmly established beyond all possibility of doubt. It is not uncommon to find a patient who complains of respiratory symptoms and who gives a history of 'pleurisy' months or years previously. In such cases the patient rarely knows whether the pleurisy was wet or dry, and the physician may even be in doubt whether the condition was a pleurisy at all. A simple statement by a patient that the chest was punctured and a sample of fluid removed is sufficient to clarify the situation at once.

**Aspiration.**—An important decision which has frequently to be made is whether or not the fluid should be removed. It may be stated that, as a general rule, the average effusion will be absorbed spontaneously in about six weeks, and therefore it is clear that routine aspiration is unnecessary. When the fluid is allowed to be absorbed at its own pace it is found that there is little irritation of the pleura, and the membrane may return to its normal state; the fact that patients are seen who have had a recurrence of an effusion on more than one occasion in the same part of the chest is proof that it can be absorbed without leaving gross pleural adhesions. There are some cases, however, in which aspiration must be performed. The chief indication is shortness of breath, which accompanies a rapidly developing effusion. Another indication is to prevent thickening of the visceral pleura in cases in which absorption of the fluid is unduly slow.

**Pneumothorax.**—Replacement of the aspirated fluid by air is necessary in certain cases. Effusions which recur rapidly after removal can be controlled to a considerable extent by air replacement; as much fluid as possible is withdrawn and about two-thirds of the amount of air is injected; the procedure is carried out at one sitting, using a special two-way cannula. This type of air replacement is of special value in cases of recurrent effusion due to malignant disease. Finally, air replacement may be done in order to secure a satisfactory x-ray film showing the state of the underlying lung and pleura, which are of course obscured by the fluid in a plain film. Growth may thus be disclosed in the lung or on the pleural membrane, or cavities may become visible. When the condition is proved to be tuberculous it may be decided to continue with injections of air, thus constituting an artificial pneumothorax, which can be kept up for as long as may be necessary.

**Drugs** are not of much value in assisting in the absorption of fluid. It is said that the intravenous injection of a 5 per cent solution of calcium chloride is of value in promoting resolution. Sometimes an aching pain is felt in the lower part of the chest

for some considerable time after an effusion has been absorbed; usually, a mustard leaf or a blister will control the symptom.

The after-care of a case of tuberculous pleurisy is a most important matter. It is not usually necessary to advise sanatorium treatment in cases the lung is not involved, as these patients are better kept carefully away from contact with tubercle bacilli. It is best to send them to the country or to the sea to live a quiet life on sanatorium lines for between three and six months. Sun-bathing and sea-bathing must be expressly prohibited. A generous diet and carefully regulated exercise should result in a moderate increase in weight. An unduly rapid gain usually means that the patient is not taking sufficient exercise, and an unhealthy fatness with flabbiness is the result.

## Anaemia in Pregnancy in Calcutta An Analysis of Haematological and other Data from 529 Pregnant Women

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and

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(From the *Indian Medical Research Memoir* No. 33.  
December 1941)

### Summary of observations

Blood examinations were carried out and an analysis is made of the blood picture in 128 'normal' non-pregnant women, in 64 'normal' pregnant women and in 467 pregnant women clinically chosen as anæmic; of these women of the last group, 386 were first examined before parturition and 81 after parturition.

For the purpose of analysis the anæmic women were divided into three classes, A—markedly anæmic, 50 per cent or less (Hellige), B—moderately anæmic over 50 per cent but under 68 per cent, and C—68 per cent or over; this last class acted as additional controls. The cases were further divided into three hæmatological groups, microcytic, normocytic and macrocytic, so that there were altogether nine sub-groups. Epidemiological, pathological and clinical data were analysed with reference to these classes, groups, and sub-groups. From this analysis the following conclusions were arrived at:—

1. The 'normal' pregnant women show a distinctly lower hæmoglobin level than the normal non-pregnant women (reported elsewhere), but no evidence of the progressive reduction of hæmoglobin percentage throughout pregnancy that has been reported by other workers; there is, however, evidence of a tendency to increase in cell size as pregnancy progresses.

2. Amongst the anæmic patients the same tendency towards increase in size of the red cell throughout pregnancy is apparent, but otherwise there is no constant change in the size of the red cell; macrocytic and microcytic anæmias usually maintain their own characteristics until cure is effected.

3. There is evidence that the removal of the fœtus, naturally, at term, or prematurely, was a more potent factor than any treatment that may have been given in bringing about improvement in the blood picture, in the macrocytic and normocytic cases, but less so in the microcytic.

4. There is evidence that there is an iron deficiency in the large majority of the cases under investigation. This iron deficiency was most evident in the class that showed the least anæmia, this anæmia-producing factor probably being overshadowed by other factors in the more anæmic classes, and, though it is more prominent in the microcytic groups, there is evidence of some degree of iron deficiency in the other groups.

5. Liver injections appeared to be effective in some individual cases, but, in the analysis of the cases as groups, there was no evidence of this effect, perhaps because a negligible number of injections were given in many cases.

6. Macrocytic anæmia is more common amongst primigravidæ; this association is independent of age, for otherwise there is less anæmia amongst young women. Microcytic anæmia is commonest amongst older women.

7. Of the severe cases coming under observation early in pregnancy, the majority were macrocytic.

8. A distinctly larger number of macrocytic cases come under observation during the second half of the year.

9. There is a very marked association between poverty and anæmia, and some correlation between macrocytosis and poverty. In the richer classes, vegetarianism appears to be correlated with macrocytic anæmia.

10. There is a significant correlation between Mohammedanism and microcytic anæmia, and also therefore with purdah.

11. There is a negative association between excessive hæmorrhage at parturition and both ante-partum anæmia and macrocytosis.

12. There is no correlation between sore-mouth and the degree of anæmia, but there is a suggestion of association between macrocytosis and sore-mouth.

13. There is a significant association between diarrhoea and to a less extent vomiting, and macrocytosis.

14. There is a significant association between both severe anæmia and macrocytosis, and œdema.

15. There is a significant association between severe macrocytic anæmia, and both spleen and liver enlargement.

16. Albumin in the urine is significantly more frequent in the severe anæmia class.

17. Hyperbilirubinæmia is definitely correlated with severe anæmia and macrocytosis.

18. There is a positive correlation between reticulocytosis and both the degree of anæmia and macrocytosis.

19. In the severe macrocytic anæmia group hyperbilirubinæmia is correlated significantly with liver enlargement and spleen enlargement, but in the rest of the cases in the severe anæmia group it is correlated only with splenic enlargement.

20. There is considerable evidence of an ætiological association of syphilis or some other Wassermann-positive-producing factor, in the severe anæmia groups, for a positive Wassermann reaction was obtained in over 20 per cent, and in over 25 per cent of the 'poor' patients of this group; in the case of the latter the difference between the macrocytic groups and the rest is significant. There is also a strong suggestion that a positive Wassermann is particularly associated with macrocytosis.

21. The maternal deaths recorded were mostly amongst the macrocytic and normocytic cases.

22. Prematurity and early death of the child both show a high correlation with severe anæmia and macrocytosis. The neo-natal death rate in the anæmic classes is over 36 per cent amongst infants of mothers with macrocytic anæmia, 20 per cent amongst those with normocytic, and was *nil* amongst those in our series with microcytic anæmia. This is also evident amongst those cases first seen post-partum, for the neo-natal death rate was over 30 per cent in the combined macrocytic and normocytic groups and again *nil* in the microcytic.

23. In the post-partum cases there was evidence of a rapid decline in the influence of the macrocytic-anæmia-producing factor.

### Conclusions

*Ætiology.*—One of the objects in carrying out this inquiry was to obtain evidence of the important ætiological factors in the development of severe anæmia in pregnant women in Calcutta, and thus provide a rational basis for a campaign against the high anæmia mortality.

Considerable evidence was found in the whole series of cases of an *iron deficiency*. The hookworm infection rate was negligible amongst the patients whose stools

were investigated, and, as it is not usually high amongst women of the class from which the patients were drawn, it seems probable that the origin of this iron-deficiency anæmia is dietary, *i.e.*, the iron intake is insufficient for the extra requirements of the pregnant woman. The higher incidence of anæmia in the lower economic groups supports this suggestion and the fact that this 'poverty' anæmia is not predominantly microcytic is not necessarily against it, for it is probable that the microcytic picture of the anæmia is overshadowed by other influences.

A relative iron deficiency occurring in the child-bearing period of life with a tendency to exacerbations during pregnancy and lactation is well recognized in other countries and is especially common amongst the poor whose iron intake is near or below the borderline of the body's requirements. In our series the pure microcytic anæmias occurred mainly in multiparæ and older age groups suggesting that iron depletion during earlier pregnancies may have been the cause.

Microcytic anæmia appeared to be associated with the observance of purdah. The pallor and debility which results from close confinement to the house and lack of fresh air and sunlight is probably similar to the chlorosis of a previous generation in England, which quickly responded to iron therapy.

This iron deficiency, however, though widespread, is of secondary importance in this series of cases of anæmia, for the majority, as well as most of the worst cases, were macrocytic. The far greater frequency of very severe anæmia amongst the macrocytic group may be evidence that the macrocytic-anæmia-producing factor is the dominant one.

The production of macrocytic anæmia appears to be influenced by several factors. In the first place, it appears to be connected in some way with the presence of the fœtus; the anæmia and the macrocytic tendency show a progressive increase throughout pregnancy, both in the anæmic patients and in the controls, and they tend to decrease immediately after parturition. Secondly, that this anæmia is nutritional in origin, is suggested, not only by the higher incidence in the lower economic classes, but by the fact that it is the macrocytic type that is more closely correlated with low economic status and that in the richer classes, vegetarianism, with its lower protein intake, is correlated positively with macrocytic anæmia. It is possible that the higher incidence of anæmia and macrocytosis in the second half of the year is connected with the less varied dietary, and with a lack of fish and vegetables, that is taken during the hot weather and monsoon months. Further, the common association of macrocytic anæmia with sore-mouth, another deficiency condition, still further suggests a nutritional defect.

Thirdly, the association of severe macrocytic anæmia with primigravidity, independent of age, its occurrence relatively early in pregnancy, and its association with premature delivery and a high neo-natal death rate, suggest comparison with the toxæmias of pregnancy. This is further supported by the common association of macrocytic anæmia with œdema and albumin in the urine.

The significant positive correlation of severe macrocytic anæmia with enlarged spleen and liver, hyperbilirubinæmia and reticulocytosis all point to some hæmolytic condition and are especially suggestive of chronic malaria. Malarial parasites were recorded in only a few cases, but this is beside the point as it is not suggested that acute recently-acquired malaria is the cause, but chronic, or 'latent', malaria with hyperreticulo-endotheliosis.

Another suggestion for an ætiologically associated infection is provided by the high correlation with a positive Wassermann reaction (with the possible proviso that this positive Wassermann reaction may be another manifestation of an association with malaria).

Finally, the occurrence of diarrhoea or a history of dysentery, often accompanied by prolonged adherence to a limited and unbalanced diet, suggest a state of gastro-intestinal dysfunction. This raises other ætiological possibilities for which added evidence is

provided by the similarity of this type of anæmia to the macrocytic anæmia which occurs in association with sprue and celiac disease.

To summarize, findings seem to suggest that the macrocytic anæmia of pregnancy is a 'conditioned' toxæmia, that is, a toxæmia associated with the presence of the fœtus and conditioned by a low dietary intake, or deficient absorption, of certain essential blood-forming and protecting substances, the syndrome being aggravated by (or perhaps only operative in the presence of) a chronic malarial infection, with the associated hyper-reticulo-endotheliosis and excessive blood destruction which causes an extra demand for these blood-forming essentials, by chronic intestinal infections and diarrhœa with consequent exaggeration of mal-absorption, and/or by syphilis with its hæmopoietic depressing action.

Such a conditioned toxæmia is not purely hypothetical and has been shown to occur in connection with both lead and selenium poisoning and with sulphanilamide administration; in the former case it is recognized that people on a rich diet may escape the effects of lead poisoning, whilst others on a poor diet suffer, and recently Smith *et al.* have shown that in animals a high protein diet will counteract the effect of chronic selenium poisoning and the hæmopoietic depressing action of sulphanilamide.

The fact that a macrocytic anæmia similar in many respects to the macrocytic anæmia of pregnancy occurs, although less commonly, in men in Calcutta, suggests that, as in the case of the iron-deficiency anæmia, the fœtus is the last straw that breaks the camel's back.

*Clinical picture.*—A further object in mind in carrying out this inquiry was to correlate clinical syndromes with different hæmatological groups, so that treatment in the absence of complete blood examination might be more rational. The findings of the inquiry have, however, in the first place impressed on the workers the complexity of the problem of the anæmias met with in Calcutta and the absence of any clearly-defined clinical types which can be correlated with the hæmatological groups according to which the cases were analysed. It is probable that one reason for this is, as has already been suggested, that an iron-deficiency condition may underlie other superimposed types of anæmia, leading in many instances to a confused hæmatological picture. Our findings do, however, emphasize the existence of marked clinical differences between cases of moderate anæmia (class B) as compared with severe anæmia (class A), and further, certain clinical distinctions can be drawn between the severe macrocytic anæmias and the severe microcytic anæmias in class A.

The main differences between moderate and severe anæmias in general can be summarized as follows:—

In moderate anæmia (class B) the patient usually makes no complaints and the condition is found on routine examination. On inquiry she may admit to feeling tired, but many women expect this in pregnancy and think nothing of it. On examination some pallor of the mucous membranes of the mouth (and of the vagina, if the pelvis is healthy) is a more reliable guide to the degree of anæmia than the conjunctivæ or nails. The heart may be normal, but in the borderline cases will probably show a hæmic murmur or slight dilatation.

Post-partum hæmorrhage is rather more likely to occur in these moderate cases than in very severe anæmia.

In severe anæmia there may or may not be presenting symptoms. The degree of anæmia which may develop without complaints is a striking testimony to the low standard of well-being with which so many women seem satisfied. It is not uncommon to find a hæmoglobin of 30 to 40 per cent on routine examination. In more severe cases in this group, questioning will, however, elicit symptoms of shortness of breath, palpitations and often swelling of the feet and face. Diarrhœa is sometimes the presenting symptom. On examination, marked pallor is seen, and the skin often has an 'alabaster' appearance, due to

a combination of pallor and œdema; according to the degree of severity, the following signs will be found: œdema of feet, face or of the whole body; a degree of dilatation of the heart, a systolic murmur localized in the pulmonary area or audible all over the præcordium; the spleen may or may not be palpable.

Premature delivery, stillbirth and neo-natal deaths are common in this group. Tendency to post-partum hæmorrhage is not marked; sepsis in the puerperium is a danger.

The differences between the macrocytic and the microcytic cases in class A (severe anæmia) can be summarized as follows, but it must again be emphasized that the types are not by any means clear cut.

*Macrocytic anæmia* has a seasonal incidence and cases tend to occur in the second half of the year. It is found on the whole rather more often in the first and second pregnancies irrespective of the age of the patient. These cases come under observation earlier in the course of pregnancy than the microcytic type and show a greater tendency to spontaneous recovery after parturition. They respond little, if at all, to iron therapy. Symptoms include a larger proportion of cases with a history of diarrhœa or dysentery than in the microcytic type. A yellowish tinge of the conjunctivæ and skin is often noticeable, corresponding to the large number in this group who show evidence of hyperbilirubinæmia. The mouth may be sore and the tongue be seen to have a shiny smooth appearance with red sore patches. It is usual to find enlargement of the spleen and liver. Labour is often premature, generally easy, and these cases do not often suffer from post-partum hæmorrhage, although delay in delivery of the placenta is not uncommon. The added strain of labour may be more than the enfeebled circulatory system can stand, and in extreme cases death occurs from heart failure during or soon after delivery. The neo-natal death rate is very high. A positive Wassermann reaction was more common in macrocytic than in microcytic cases in our series.

The severe *microcytic anæmias* show a positive correlation between Mohammedanism and purdah, the influence of the one perhaps overshadowing the other. Cases of this type of anæmia tend to come under observation later in the course of pregnancy than the previous type. Cases occur at a later age period and in the later pregnancies. The tendency for spontaneous recovery after delivery is less marked, but the reaction to iron both during pregnancy and afterwards is good. The conjunctivæ and mucous membranes of cases in this group are dead white rather than yellowish white, and signs of enlarged liver and spleen, sore-mouth and intestinal complaints are less common, although by no means always absent. Heart failure in severe cases is equally possible, although in the series under investigation no microcytic case died; the explanation of this may be that severe microcytic cases were uncommon, for the very severe cases both factors were probably operating and the macrocytic picture predominated.

The neo-natal death rate is low, and was actually nil in this series, for the infant has the first call on the available iron.

#### *Recommendations regarding prophylaxis and treatment*

It was no part of the programme of this investigation to assess the value of any particular form of treatment, and in fact we had very little opportunity to do so, for in the severe cases usually many different forms of treatment were given in quick succession or at the same time; our recommendations are therefore based on deductions from our hæmatological observations combined with other experience on our part and on that of others.

*Prophylaxis.*—It is encouraging to consider that no other fatal complication of pregnancy can, in theory, be so easily prevented if taken in time, as severe anæmia.

Pre-natal care must include constant watchfulness for any signs of development of anæmic states. Regular examination of the woman for pallor of face and mucous membranes, and the rough estimation of the hæmoglobin by the Tallqvist method, are a matter

of a few moments' work, are within the capacity of any trained midwife to carry out, and will serve to detect all the grosser cases. The medical examination which should be undertaken in the early months of pregnancy should include a careful inquiry into the history of hæmorrhages, especially with reference to their frequency, of malaria, dysentery and syphilis, and of anæmia and œdema in previous pregnancies. The diet should be inquired into and any deficiency adjusted. Physical examination should be directed especially towards the colour of the mucous membranes, the presence of a hæmic murmur or dilatation of the heart, the condition of the spleen and liver, œdema of feet and the examination of the urine and blood pressure.

The pregnant woman's diet should ordinarily be the diet to which she is accustomed, with any necessary additions to make it 'balanced'. A pint of milk should be considered a minimum requirement, and this is more especially important in a vegetarian diet. Some substance rich in vitamin-B complex (sprouting gram, rice polishings, Marmite) should be taken, and articles containing a plentiful supply of salts including iron should be encouraged. Sunshine and fresh air should be insisted upon, and women who observe purdah should take extra vitamin D.

All pregnant women of the classes from which we drew our cases should be given iron by mouth as a prophylaxis during pregnancy. It is suggested that the first course should be given in the 3rd or 4th month and the second between the 6th and 8th month.

If a patient has an enlarged spleen or gives a history of malaria, a course of quinine may be advisable. This should be given after the 3rd month is completed, and not at the time when menstruation would have occurred, and the patient should rest during the administration. The quinine should be given in 5-grain doses, three times a day combined with bromide. The chances of quinine causing abortion is exaggerated; the dangers to which the fœtus is subjected are far greater if quinine is withheld than if it is administered in moderate doses, but the time for its use should be carefully chosen, unless active malaria is present when in any circumstances thorough treatment must be given.

A Wassermann reaction should form part of a pre-natal examination and, if it is positive, treatment should be instituted.

If a history is obtained of severe anæmia in a previous pregnancy, a prophylactic course of iron by mouth, and liver by mouth or injection should be given early in pregnancy and blood examinations made at intervals throughout.

*Diagnosis and treatment.*—The first essential is accurate diagnosis and the detection of underlying and associated diseases. When anæmia is found, a full hæmatological examination should be carried out to discover the type of anæmia present, the stools and the urine should be examined, the blood pressure taken and a Wassermann test carried out.

The earlier treatment is instituted the more likely is the patient to respond.

*Treatment in pregnancy.*—The diet should be inquired into and suitably supplemented.

Sunlight and fresh air should be insisted upon.

If the anæmia is microcytic hypochromic, iron should be given in full doses, e.g., ferrous sulphate tablets, 6 grains twice a day after food, iron and ammonium citrate, 40 grains three times a day, or better still ferrous ammonium sulphate, 20 grains with glucose twice daily. All iron preparations should be given after food with a glass of water. Full doses of iron are not constipating, but diarrhoea and indigestion are sometimes complained of, and the pregnant woman is more particularly sensitive in this respect. The tablets and pills are more irritating than mixtures but the former keep better and are easier to administer. Iron 'plastules', a proprietary preparation that contains peppermint, are also convenient and will be found

useful in cases in which the ordinary ferrous iron tablets cause gastric irritation.

If the anæmia is macrocytic and hyperchromic, liver extract should be given by mouth or injection. In pregnancy the time factor is important and injection is to be preferred.

If the anæmia is normocytic and orthochromic both liver and iron are indicated.

When there is failure to respond to treatment, the question of blood transfusion arises. Large transfusions are generally contra-indicated by the state of the circulatory system (œdema, etc.) but small transfusions may be given, or better still transfusions of moderate size by the drip-feed method. It is, however, doubtful whether evidence has been produced to show that these are any more effective than intramuscular injection of whole blood, which obviates grouping, is much easier to obtain, less distressing to give, and does not contain the risk of severe reactions, which seem particularly liable to occur in very anæmic women given intravenous transfusion.

Intramuscular injections, 20 c.cm. on alternate days, should certainly be tried in cases that fail to respond to other treatment.

A reticulocytosis should be observed in about a week. It should be remembered that anæmia will not respond to treatment in the presence of active sepsis.

(In milder cases of anæmia when facilities for blood examinations are not available, it is a good working rule to give a course of iron and observe the result; if there is no improvement, liver injections should be given in addition. If the skin shows a yellowish tinge, liver should be given from the first and a careful inquiry for underlying conditions, e.g., malaria, syphilis, dysentery, carried out.)

*During labour.*—Many cases of severe anæmia come under observation for the first time when labour has begun.

In very severe cases the patient is suffering from a degree of heart failure and anoxæmia, and the strain of labour through which she has to pass may well be too much for her cardiac reserve. Labour in these cases is, however, often premature and generally easy (cf. labour in cardiac disease, with which these cases have much in common), and it is surprising how women with red cell counts of a million, or even just under a million, may survive.

A minimum of excitement and disturbance of the patient is necessary, and delivery should be allowed to take place in a quiet room, preferably on a bed, with the patient half sitting, well propped up on pillows, or with a back rest. Frequent small feeds with plenty of glucose should be given. Sedatives usually helpful are paraldehyde, bromide and chloral. Morphia may be needed, and has the added advantage of preventing the tendency to restlessness which is induced by the cardiac distress and anoxæmia. It may have to be combined with atropine, if there is œdema of the lungs.

The œdema and disturbance of the circulatory system contra-indicate the use of large transfusions of blood or subcutaneous injections of fluid, but small intravenous injections of glucose may be used to tide the patient over a critical period.

We have observed no good results from hypodermic injections of strychnine and digitalin, but camphor and coramine sometimes seem to help. On the whole, sedatives are indicated rather than stimulants.

The third stage should never be hurried. Efforts to express the placenta are particularly exhausting to the patient and should never be made. Post-partum hæmorrhage is rare in severe anæmia but particularly dangerous if it does occur. Spontaneous expulsion of the placenta nearly always occurs unless death is imminent.

*Treatment in the puerperium.*—If the patient with very severe anæmia survives the first 3 days after delivery she nearly always recovers, unless sepsis supervenes. The danger of puerperal infection is however very great, and, in some conditions of practice, it is probably true that as many very anæmic women



die later from puerperal sepsis as die from the effects of anæmia and the strain of labour. When sepsis occurs the difficult question arises of the use of the sulphonamides with their depressant effect on the hæmopoietic system. But as the anæmia will not

improve in the presence of the marked sepsis, there is no alternative but to give them combined with iron, liver and intramuscular injections of whole blood, or continuous blood transfusion when circumstance permits, at the same time.

## Reviews

**TROPICAL MEDICINE.**—By Sir Leonard Rogers, K.C.S.I., C.I.E., LL.D., M.D., B.S., F.R.C.P., F.R.C.S., F.R.S., and Sir John W. D. Megaw, K.C.I.E., B.A., M.B., Hon.D.Sc. (Queen's University, Belfast). Fourth Edition. 1942. J. and A. Churchill, Limited, London. Pp. xii plus 536 with 2 coloured plates and 87 text-figures. Price, 21s.

A NEW edition of this well-known book will be particularly welcome at this time when many people unfamiliar with the tropics are being sent out for service abroad. There is probably no more readable book on tropical medicine than that of Rogers and Megaw. It is of convenient size and reasonably comprehensive. Although there are not very many extensive changes in this edition, the subject has been brought more or less up to date, and the authors have kept themselves well abreast of the times, in spite of the fact that they have been divorced from practice in the tropics for a number of years.

Among the additions, we notice that sulphonamides have been advocated in plague, oriental sore, granuloma inguinale, tropical ulcer, and undulant fever, chiniofon in amœbiasis, and nicotinic acid in sprue; Boyle's classification of the dysentery bacilli is now included; the new diseases dealt with include Bornholm's disease (incidentally however this new addition has not found place in the index) and Colorado tick fever.

There are naturally some matters for criticism: Beri-beri is still included under diseases of doubtful ætiology; vitamin-B<sub>2</sub> deficiency has been given as the cause of pernicious anæmia; atabrin is said to be toxic to infants; and very minute doses of atabrin are advocated in blackwater fever. There is one mistake which was possibly only an unfortunately expressed sentence, but which might lead to serious misunderstanding; under the heading 'yellow fever' is the following sentence: 'The viscerotome should be used in all areas where the disease is expected to exist; by the use of this instrument early cases can be detected'. The viscerotome is of course only used for making a post-mortem diagnosis, so that 'early cases' in which one attempted to make a diagnosis by its use would, I am afraid, shortly be referred to as 'the late'.

We believe this new edition will maintain the popularity of the previous editions.

**SURGERY. (CATECHISM SERIES.)** Fifth Edition. Parts I and II. E. and S. Livingstone, Edinburgh. Pp. 70 with 8 x-ray plates in Part I and from 71 to 140 with 8 x-ray plates in Part II. Price, 1s. 6d.; postage 3d. for each part

A NEW edition of surgery in Livingstone's excellent catechism series has appeared. There must be few students in the British Isles who are not familiar with these valuable books. There are in this edition many helpful skiagrams which some of the earlier editions did not have. They are all relevant, show what they are meant to show, and are well reproduced.

One is tempted to say that they are almost an essential to a student about to take his surgery finals.

**THE M.B., B.S. FINALS. A COLLECTION OF THE PAPERS SET AT THE LONDON M.B., B.S. EXAMINATION FOR THE YEARS 1925 TO 1940, CLASSIFIED AND ARRANGED IN SUITABLE SUBDIVISIONS.**—By F. Mitchell-Heggs, M.B., B.S. (Lond.), F.R.C.S. (Edin.), Major, R.A.M.C. Second Edition. 1941. J. and A. Churchill Limited, London. Pp. xvi plus 96. Price, 7s. 6d.

THIS book can be recommended to the student and also to his examiner. Examiners in this country do not always set their questions in a form readily understood by the student. The setting of questions is an art, to achieve which nobody need be ashamed of seeking help from others; the examiners in the London M.B. are experienced, and useful guidance may be obtained from them.

If the student can answer all the questions that are found in this book he knows his subject and can face his examiners with confidence.

**ESSENTIALS FOR FINAL EXAMINATIONS IN MEDICINE.**—By John De Swiet, M.D. (Lond.), M.R.C.P. 1941. J. and A. Churchill Limited, London. Pp. viii plus 168. Price, 7s. 6d.

THIS is not a cram book, but it is a book that will be very useful for the purpose for which it was designed, namely, for rapid revision just before taking the medical finals.

Its usefulness will not end there as it will still form a very valuable small book of reference. It is not comprehensive but it covers a wide field.

The few tropical diseases that are included are treated in an orthodox way, though the reviewer doubts if a 1 in 50 agglutination is diagnostic of Shiga infection. A few lines lower, the dosage of Shiga antiserum '6 to 10,000 units' is a little startling, though the meaning 'six to ten thousands units' is obvious.

This little book is a very valuable pocketful at a very reasonable price, and we can recommend it to the physician and would-be physician alike.

**ARCHITECTURAL PRINCIPLES IN ARTHRODESIS.**—By H. A. Brittain, M.A., M.Ch., F.R.C.S. 1942. E. and S. Livingstone, Edinburgh. Pp. xi plus 132. Illustrated. Price, 21s.; postage, 7d.

ARE the modern methods of joint arthrodesis as good in technique and as successful in results as they might be?

The author of this monograph was disappointed with the results of orthodox methods of arthrodesis and set out to improve them by working on architectural principles.

Briefly, these principles are that the bone graft used should be placed in compression, not in tension, that its breadth should be in position of maximum stress; where possible two grafts, crossing, should be used, and that the graft should be properly protected. The author then goes on to explain his technique and operative steps when using bone grafts on these principles. He explains how best they may be cut and how adapted to the fusion of the various joints, ankle, knee, hip, thumb, wrist, elbow, shoulder and spine.

Clear, easily-understandable and useful illustrations, some in colour, are a feature of this small book, and photos of x-ray films illustrate end results.

This is an interesting and instructive monograph for orthopaedic and general surgeons.

K. S. F.



## Abstracts from Reports

### THE ELEVENTH ANNUAL REPORT OF THE ASSOCIATION FOR THE PREVENTION OF BLINDNESS, BENGAL, 1940-41

THE association has now completed the eleventh year and as will be seen from the results obtained in this report, it has justified its existence as one of the most popular and active utility services in Bengal. As the work grows more each year and its activities extend to more remote villages, it is encouraging to find how eager the people are to take advantage of the benefits it provides in dealing with the problem of prevention of blindness and cure of eye diseases. Prevention of blindness is not the problem of only one agency, government, municipalities, district and union boards, the medical profession, parents, guardians and teachers must do their share in tackling the problem. The association tries to co-ordinate the work and educate the lay public in the importance of the movement of prevention of blindness.

Within its limited resources, the committee have been able to carry out the greater part of their programme. One of the long cherished hopes and chief aims of the association has been realized this year, viz, to have five travelling eye dispensaries for the five divisions of Bengal. The fifth travelling eye dispensary started its work in the Murshidabad district on the 12th March, 1941.

The committee have so far not been able to do much in the way of legislation against couchers, quacks and other unauthorized practitioners. These charlatans do a tremendous amount of damage in Bengal. We once again appeal to the government and members of the legislature in the province to take up the matter which is of vital public importance and thereby earn the gratitude of thousands of persons.

*Enumeration of the blind.*—In the Bengal census for 1931, amongst other counts of disabilities, the enumeration of the blind was undertaken. A person is considered blind who is unable to count the fingers of an out-stretched hand when placed close up to the eyes. This enumeration of Bengal revealed a figure of 73 persons blind per 100,000 which may be taken as a rough figure.

With the starting of the first travelling eye dispensary in Bengal by this association in 1936 an attempt was made to estimate the number of blind persons in the villages of Bengal. At first, progress was very slow but as other travelling eye dispensaries came into existence and there are now five working, we have been able to carry out counts in 500 villages and have obtained a figure of 148 blind persons per 100,000 which is about double the figure ascertained by the 1931 census.

*Rural reconstruction.*—During the year many comprehensive schemes have been launched for rural uplift and natural constructive work to improve the conditions of the life of the villagers. Large sums of money are being spent to provide good water supplies, improved methods in the breeding of cattle, union board dispensaries, village schools, libraries and playing grounds. The Travancore State in matters of rural reconstruction and village uplift has set an example. The Government of the Punjab is also doing much in this connection.

The work of the five travelling eye dispensaries in the districts and the eye examination and lecture unit in and around Calcutta has been most gratifying.

*Propaganda.*—The propaganda work of the association has been still further increased by the activities of the eye examination and lecture unit commonly called the 'E.E.L.U.' which was started two years ago.

A special syllabus of lectures for the teachers and students of schools in Bengal has been drawn up by the association and lectures are being delivered in

accordance therewith. This is financed out of a special grant made by the Bengal provincial branch of the Indian Red Cross Society, Calcutta, to the association. These lectures were greatly appreciated by the various schools in which they were delivered.

During the year a new set of magic lantern slides depicting the work of the travelling eye dispensaries in mofussil areas has been prepared from actual snapshots and photographs taken by these dispensaries.

In addition to our work of prevention during the year 106,485 cases have been treated in the mofussil by the five travelling eye dispensaries.

Funds are most urgently required and the committee are always anxious that the activities should not be curtailed by insufficiency of money.

### REPORT OF THE SCIENTIFIC ADVISORY BOARD FOR THE YEAR 1ST JANUARY TO 31ST DECEMBER, 1941

In connection with the cholera field enquiry in Bengal under Dr. S. R. Pandit, the percentage of positive isolations was 81 and at the height of the epidemic 92 per cent were positive. The Ogawa sub-type prevailed. Non-agglutinable vibrios were not encountered in higher proportion in negative cases than in association with the agglutinable vibrios in positive cases. Direct plating gave a higher proportion of positive results than enrichment methods. A further study was made of vibrio haemolysis and it was found that strains could be divided into two groups: (a) 'early haemolytic' corresponding to Greig-positive strains and (b) 'late haemolytic' corresponding to Greig-negative strains.

Two outbreaks were investigated in different areas by the Director, King Institute, Guindy.

The examination of a large number of tank waters near Negapatam showed the presence of agglutinable vibrios of the Ogawa haemolytic type. The method of filtration in the field and the use of buffered KCl-boric acid saline with transmission by post to the laboratory for subsequent culture in modified Wilson and Blair medium proved successful.

Cholera bacteriological enquiry was carried out at the School of Tropical Medicine, Calcutta, under Dr. G. Panja. A few cases were treated with human plasma and no opinion can be given on the value of the method.

Brilliant green in 1 in 5,000 dilution was given by mouth in half-ounce doses every 2 hours. Clinical improvement was noticed.

Histological examinations were carried out by Dr. D. N. Banerjee. The vibrio was found in the wall of the small intestine but rarely in the wall of the large intestine. Vibrios were present in the mucosa, the sub-mucosa and at the base of Lieberkühn's follicles but only in rare instances in the sub-serous layer. Histological examination showed evidence of reaction of inflammatory nature with necrosis and desquamation of epithelium. The Peyer's patches and solitary follicles and mesenteric glands showed hyperplasia and necrosis.

Clinical trials were carried out on the value of transfusion with concentrated saline solution (20 per cent) in cases of collapse with high specific gravity of the blood and encouraging results were obtained.

The observations made in India by all enquiries made so far have not shown the existence of any direct association of the El-Tor type of vibrio with a cholera case although strains of this type have been isolated from water in Bengal, Madras, Bihar and Sind. The El-Tor type of vibrio has not been isolated from stools of either healthy persons or of cholera cases. The studies made in the last year have shown that although haemolysis may be produced under certain conditions by vibrios which can be classified as true *V. cholerae* there are differences in the type of haemolysis as compared with that produced by El-Tor strains which enable the two to be differentiated.

The research activities of the Malaria Institute have necessarily been greatly curtailed owing to the

abnormal conditions brought about by the war. The post of malaria research officer remains vacant and several of the most experienced members of the staff are serving overseas. In addition to the annual malaria courses for medical officers and engineers respectively, three special courses for military personnel have been held during the year, and the total number of those who have received training at the Delhi field station since the outbreak of war is 122.

Much work has been done in regard to the testing of insecticides and mosquito repellents. Pyrethrum insecticides have continued to give the best results for spray-killing adult mosquitoes. The repellent value of pyrethrum extract has also been demonstrated, as a result this now forms the chief ingredient of the anti-mosquito cream supplied to the army overseas.

Many tests have been carried out on sprayers, both for spray-killing of adult mosquitoes and for the application of larvicides. An improved hand sprayer and a knapsack oil sprayer, from which rubber diaphragms and washers have been eliminated, have been designed, and are now being supplied to the army.

Little progress has been made in the study of the schizogony cycle of *Plasmodium heroni* and the course of the disease in the host (paddy birds). This, according to the author (Dr. B. C. Basu), was due to his undertaking the preparation of the Malaria Transmission Memoir which has since been compiled.

A filariasis survey was carried out by Dr. Sundar Rao in 9 villages in Cachar district, where the infection is said to have been introduced in recent years from Bihar. Night blood smears from 2,445 persons showed a gross infection rate of 4.7 per cent. Out of 115 carriers, 5 were *Mf. bancrofti* and the remainder *Mf. malayi*. The percentage showing clinical signs of the disease was 4.5.

Pharmacological enquiry under Dr. B. B. Dikshit, Bombay, has shown that sulphathiazole has little action on the cardio-vascular, gastro-intestinal, genito-urinary and central nervous systems when given intravenously, but exerts a stimulant action when applied directly to the central nervous system by ventricular or cisternal puncture. It is rapidly absorbed and excreted when given orally, the channel of excretion being the kidneys. It permeates the placental barrier fairly easily, and is found in measurable quantities in the cerebro-spinal fluid. It is superior in the local treatment of wounds to the other sulphanilamide derivatives tested. A suspension of the drug in cod-liver oil gave promising results in the treatment of burns.

Experiments with the cross circulation technique in the study of immunity in monkey malaria yielded the following results:—

(i) An immune monkey retains its immunity to *P. knowlesi* even when nearly 80 per cent of its blood is replaced by that of a normal monkey.

(ii) A normal monkey acquires immunity when 75 per cent of its blood is replaced by that of an immune monkey; if the replacement is 50 per cent, immunity may or may not be acquired; if it is 33 per cent or less, immunity is not acquired.

(iii) If 70 per cent of blood from a freshly infected monkey is replaced by immune blood, the animal passes into a stage of chronic infection.

The experiments show that both cellular humoral agencies play a part in conferring immunity in malaria infections.

Malaria surveys were carried out by Dr. D. K. Viswanathan in two collieries, two tea estates and in Sadiya, the headquarters of the Sadiya Frontier Tract, and in two urban areas.

The nutritive value of soya bean has been studied by experiments on animals and also by controlled experiments on school children. The general conclusion is that soya bean, considered as a supplement to typical Indian diets, is not of outstanding value; it does not appear to have any advantage over various

common pulses which have long formed part of the diet of the Indian people.

Shark-liver oil is now being produced in the Madras Presidency (Calicut), Bombay, Travancore and Baroda, total production amounting to considerable quantities. Rapid progress has been made in this newly created industry and it appears that the lack of cod-liver oil resulting from cessation of imports can easily be made good, as far as vitamin A is concerned, by developing indigenous supplies of fish-liver oil rich in vitamin A.

A satisfactory fluorometric method of testing for riboflavin has been worked out by Dr. W. R. Aykroyd.

Superficial keratitis due to riboflavin deficiency has been described in India for the first time. Numerous cases were observed in the Government Ophthalmic Hospital, Madras. Typical cases show superficial opacities in the cornea and circumcorneal injection, and complain of a burning sensation in the eyes, photophobia, lacrymation and dimness of vision. The ophthalmic condition is usually accompanied by angular stomatitis and fissuring of the tongue. In males a rough scaly condition of the skin of the scrotum is often observed. The effect of injections of pure riboflavin on the eye lesions is immediate and striking, improvement being often observed within 48 hours or less. A suitable initial dose is 4 milligrammes of riboflavin. Oral administration is less immediately effective than parenteral injection. While relief on treatment with the pure vitamin is usually rapid, there is a tendency towards recurrence when treatment is stopped and the patient returns to his customary riboflavin-deficient diet.

Investigations have been carried out by Dr. N. C. Datta at the Grant Medical College, Bombay, in about 300 clinical cases in order to study the range of changes usually observed in the proteins of the plasma in various pathological conditions and their significance.

Eight cases of nutritional oedema showed that the total protein was much below the normal average, being only 4.7 per cent. The deficiency was entirely due to the albumin fraction, a value of 2.5 per cent based on 15 determinations being obtained. In a few cases of oedema of a severe type in children the globulin was found below to be normal. The oedema of malnutrition in children was found to be successfully eliminated by dietetic treatment, while that in adults appeared to be more resistant to treatment.

More than 50 cases of different types of anaemia showed a general reduction of total protein from its normal average of 7.0 to 5.5 per cent, the albumin fraction being subject to reduction. Twenty cases of anaemia with oedema had an average albumin content of 3.0 per cent. In 5 out of 50 cases the plasma protein was found to be within normal limits.

In connection with leprosy enquiry under Dr. John Lowe at the School of Tropical Medicine, Calcutta, a method has been evolved for obtaining from leprosy material the leprosy bacillus free from tissue. By a combination of physical and chemical methods it has been found possible to isolate the different chemical fractions of the bacilli. Tests with these fractions have shown that protein is the only antigenic fraction, and that it produces an early reaction only. On the basis of this work a test has been evolved using as antigen the acid-precipitated protein of the bacillus. The test with this antigen is at least as sensitive as the Mitsuda test, and has great advantages over it.

It is believed that this new test is of importance. The Mitsuda test takes a month to read and, if positive, causes nodulation and sometimes ulceration. The new test is read in 24 hours, the reaction does not persist, and causes no ill effects. The new test has explained some of the anomalies of the Mitsuda test and with further work may explain more. The new test should do much to facilitate further studies of the immunology of leprosy.

Plague enquiry was carried out under the Director, Haffkine Institute, Bombay. He obtained a large reduction in case mortality by the use of sulphathiazole

and sulphapyridine in comparison with mortality under ordinary treatment. With sulphathiazole case mortality was 22.4 per cent and sulphapyridine 30 per cent; a control series relating to previous experiments had a case mortality of 53.6 per cent. The respective figures in septicæmic cases were 41.9 per cent, 57.5 per cent and 90.6 per cent. Sulphathiazole appeared to give the best results. The optimal dosage was ascertained.

Dr. A. C. Ukil at the All-India Institute of Hygiene and Public Health, Calcutta, studied tuberculosis in relation to industry. A large number of contact cases were examined.

Enquiry into the incidence of positive Mantoux reactions and latent tuberculosis as judged by skiagrams in medical students and nurses was carried out by Major G. F. Taylor, I.M.S., at the King Edward Medical College, Lahore.

From the results it is obvious there is a high rate of latent tuberculosis in medical students at the time they begin their medical work. As these students come from the same classes as officers and others, recruited in the army, it is suggested that the Indian Research Fund Association should take up with the army authorities the need for miniature radiography of all recruits to the army.

The study of the following problems in connection with indigenous drugs enquiry under Bt.-Col. Sir Ram Nath Chopra, I.M.S. (Retd.), at the School of Tropical Medicine, Calcutta, has almost been completed and will shortly be communicated:—(1) hypnotic effects of Rauwolfia alkaloids, (2) pharmacological action of stilbene, (3) cataphoretic velocity of red blood corpuscles and the influence of their environment, (4) rôle of the reticulo-endothelial system in explaining drug action in certain tropical diseases, and (5) sodium and diethyl salts of p-amino-phenyl stibinic acid.

The work on the enquiry into anæmia of women in Assam was carried out by Dr. L. E. Napier at the School of Tropical Medicine, Calcutta. Animal experiments in relation to the problem of anæmia were conducted mainly along two different lines. In the first type of experiments, the object was to study the effect of sulphapyridine on the hæmopoietic system; for which purpose 10 monkeys living on the ordinary stock diet of the animal room were used. In all these cases there was evidence of a toxic depression of hæmopoietic function, the intensity of which depended not only on the dosage of the drug but also in some way on the individual susceptibility of the animals as there were considerable variations in the results.

The other line of work was designed to produce anæmia artificially in monkeys by injection of serum containing a specific hæmolysin. The result obtained so far shows that it is possible to produce a condition of micro-spherocytosis, attended with increased fragility and positive indirect van den Bergh as well as a condition of pseudo-macrocytosis during the period of regeneration from anæmia.

More recently experiments have been undertaken in monkeys to produce a state of chronic anæmia, resulting from chronic malarial infection, artificially induced in these animals.

Since January, 77 complete blood counts on monkeys, 69 on 'normals' in Shillong and 362 on anæmic patients have been done under the auspices of the enquiry.

There were two valuable publications:—

(i) *Indian Medical Research Memoir No. 33* on 'Anæmia of Pregnancy in Calcutta' [see p. 503, this issue.]

(ii) *Indian Research Fund Association Memorandum* on 'Anæmia of Pregnancy in India'.

[For reports of other researches carried out during the year and recommendations of the advisory committees one should refer to the original volume.]

## Correspondence

### PELLAGRA IN THE UNITED PROVINCES

SIR,—Dr. S. K. Ghosh Dastidar in the May issue of the *Gazette*, page 319, writing from Patna on 3rd April, 1942, wishes to draw my attention to the review of Dr. T. K. Raman (1940) and his case report (1941) published in the *Patna Journal of Medicine* and asserts that my statement that 'no cases have yet been reported from Bihar' does not hold good. I am surprised because, (1) he does not appear to have noted the first few lines of my article where I clearly mention that I am reviewing the cases reported during 1928-40—his case was reported in 1941, (2) he appears to have missed or forgotten my statement made at Patna in January 1941 during a lecture-demonstration of my pellagra cases of Bihar and the U. P., at which he was present on the front benches, that the photographs of the U. P. cases were part of my article 'Pellagra in the United Provinces' already sent to the *Indian Medical Gazette* for publication—the article was sent to I. M. G. in September 1940, though published in March 1942, (3) he appears not to have noted my reference to his case in my article, 'Pellagra in Bihar', published in *Patna Journal of Medicine*, January 1942, where on page 1 is mentioned 'in the same year and month Dr. Dastidar reported a definite case of pellagra in Bihar'. Had Dr. Dastidar been careful to note the above facts before raising the points I am sure he would not have felt the necessity of drawing my attention in April 1942 to Dr. Raman's review of 1940, nor to his own case report of 1941 regarding which I knew everything before it was published. It will thus be seen that my statement regarding Bihar as it stands in my article does hold good and is absolutely correct. However, it is gratifying to note that our efforts are bearing fruits,

interest is being created, and other cases are now being, and more will be, detected in Bihar.

N. AHMED,

Divisional Medical Officer,  
East Indian Railway.

JAMALPUR,  
8th June, 1942.

[Note.—Dr. Ahmed's paper was received for publication on 2nd September, 1940, but for lack of space we had to hold it over until March 1942.—Editor, I. M. G.]

### LEPROSY INSTITUTIONS IN INDIA

SIR,—Your May 1942 number includes an abstract of the Triennial Report of the Civil Hospitals and Dispensaries in the Central Provinces and Berar for the period ending December 1940. This abstract contains the following sentence:—'The real problem in the attack on leprosy is the occupation of space in leper homes by burnt-out cases to the detriment of cases requiring treatment and hospitalization'. It is not clear whether this sentence appears in the original report or merely represents the opinions expressed in that report, but in any case the statement appears to me to be rather misleading and to display a wrong attitude to the question, an attitude not confined to this particular province, and not infrequently expressed in public.

Most, if not all, of the leprosy institutions in the province in question were founded by private bodies, usually Christian Missions, and are still run by these bodies with aid from government which meets about half the cost, the rest being met by private contributions (chiefly from abroad). The institutions aim

at providing for persons who, as the result of their leprosy, are in need. Often, in fact usually, on admission the cases are infectious and require treatment and isolation and when not infectious they frequently are disabled from earning their living either by their physical condition or by the social stigma of leprosy. Even 'burnt-out' cases frequently require treatment, surgical and otherwise, which they cannot get elsewhere since for inadequate reasons most hospitals, including government hospitals, will refuse to admit them. Moreover, the cases which were infectious on admission, even when they become non-infectious may find return to their homes difficult or impossible. In providing for these people, the leper homes are doing an excellent work at relatively little public expense, the cost of maintenance being kept far lower than any government organization could keep it, and only a part of this low expense being met by the government.

The control of infectious diseases in a province is or should be the responsibility of the provincial or local administration. The International Congress on Leprosy, Cairo, 1938, stated that the control of leprosy is the inescapable responsibility of the government concerned. The only effective control measure against leprosy is the isolation of infectious cases, particularly those who live and/or work in contact with others, particularly children and young people.

What have most provincial and local administrations in India done towards this end? With a few notable exceptions, little or nothing. It has been left to voluntary bodies to do most of what little has been done, aided it is true by government grants, sometimes rather meagre ones. Such bodies are already assuming a good deal of the responsibility which should normally be borne by provincial governments. It is unjust that they should be blamed because they cannot more completely do the government's work for them.

In the province in question I do not know of a single leprosy hospital, colony or institution which has been established and is maintained by the government, and no real attempt has yet been made to establish government anti-leprosy work on a sound basis. I happen to know that the officers now responsible for the medical and public health work in this province are keen to improve this state of things, and wish to try to apply in their province some of the recommendations of the Report on Leprosy and its Control in India published by the Central Advisory Board of Health. This is a move in the right direction, and I have no doubt that the voluntary institutions in the province will welcome it and will do all they can to help in the work. It is hoped that other provinces in India will adopt a similar policy.

In the meantime non-government agencies should not be criticized for refusing to do what they have never set out to do, namely, to act purely as public health institutions, to confine admission to infectious cases, and to discharge cases as soon as they become non-infectious. Leprosy is a disease with both public health and social aspects and there will always be ample scope for the work of official and non-official agencies to attack the problem from both these aspects. At present the work of non-official agencies is usually greatest in quantity and best in quality. The great need is an improvement in the quality and in the quantity of work of official agencies with a view to making anti-leprosy work an integral part of the medical and public health work of provincial administrations.

JOHN LOWE.

LEPROSY RESEARCH DEPARTMENT,  
SCHOOL OF TROPICAL MEDICINE,  
CALCUTTA,  
24th June, 1942.

[Note.—The sentence in question is a quotation from the report, word for word, except that we corrected an obvious misprint; 'the attack of leprosy' was the actual phrase printed in the report.—*EDITOR, I. M. G.J*

## A CASE OF GIARDIASIS

SIR,—I have read with great interest the article, 'A Case of Giardiasis' by H. S. Andleigh, in the June 1942 number of the *Indian Medical Gazette*.

The author reports the striking results of treating a case of giardiasis with atabrin but does not offer any explanation for this, at first sight, surprising result. As this article may lead to further experiments with this method I may perhaps be permitted to suggest that the result obtained might be due to the acridine radical of the atabrin. We know that other acridine derivatives, such as Rivanol, have a very marked effect upon intestinal protozoa.

I consider the point rather important as the use of a highly complex and expensive derivate, such as atabrin, is an unjustifiable waste when equally satisfactory results might be obtained with cheaper and simpler preparations.

A. T. W. SIMEONS, M.D.

CAMP HOSPITAL, SATARA,  
28th June, 1942.

## A PLEA FOR SMALLER DOSAGE OF SULPHAPYRIDINE IN THE TREATMENT OF PNEUMONIA

SIR,—In the directions enclosed in the packages of sulphapyridine, especially Dagenan (M.&B. 693), the dosage recommended for treatment of acute pneumococcal infection is: two grammes initially, followed by same dose 4 hours later; thereafter one gramme to be given at 4 hourly interval for next 36 hours, then the dose is still reduced or interval prolonged. At any rate, one has to administer at least 14 grammes of the drug within first two days, which, in our opinion, is hardly necessary for an average case of pneumonia in an Indian subject.

Since the introduction of the drug in the treatment of pneumonia, we have extensively used it both in railway hospitals and private practice and it appears to us that in place of the recommended dosage as set forth above, the following dosage is as effective even in a case of moderate severity—when the patient is admitted 1 to 2 grammes according to severity. Thereafter one gramme (two tablets) three times a day till the temperature comes to normal, which usually happens on the third day, then the dose is still reduced according to patient's general condition. This dosage is virtually half of that recommended by the manufacturer, thereby a considerable amount of the drug is saved which is a prime necessity in these days of scarcity, inasmuch as the chance of toxic reactions (such as methæmoglobinæmia, sulphæmoglobinæmia, agranulocytosis and hæmaturia due to formation of insoluble acetyl salts), which are presumably due to a high dosage, administered in an attempt to maintain the maximum concentration in blood, is minimized. It is further possible that by employing the minimum effective dose, the patient's defence mechanism, that is, the cells of the reticulo-endothelial system, gets a chance to rise to the occasion.

JAGADISH C. BHATTACHARJEE, L.M.P.

DARJEELING HIMALAYAN RAILWAY  
HOSPITAL,  
TINDHARIA, DARJEELING,  
30th June, 1942.

## Service Notes

### APPOINTMENTS AND TRANSFERS

COLONEL G. R. LYNN, C.B.E., D.S.O., I.M.S. (Retd.), is appointed Additional Deputy Director-General, Indian Medical Service (Stores), with effect from the afternoon of the 9th May, 1942.

Lieutenant-Colonel F. H. Whyte is appointed Civil Surgeon, Simla West, with effect from the forenoon of the 11th May, 1942.

Lieutenant-Colonel W. M. Will is appointed Deputy Assistant Director-General (Medical Stores), Medical Store Depot, Bombay, with effect from 18th May, 1942, vice Major W. T. Taylor appointed as Additional Officer, Medical Store Depot, Bombay.

Major W. T. Taylor is appointed Additional Officer, Medical Store Depot, Bombay, with effect from 18th May, 1942, until further orders.

Major G. B. W. Fisher, Civil Surgeon, Dacca, is appointed to act temporarily as Surgeon Superintendent, Presidency General Hospital, Calcutta.

#### (Emergency Commissions)

##### To be Lieutenants

John Cameron. Dated 10th January, 1942.  
Eric James Currant. Dated 4th February, 1942, with seniority from 3rd May, 1936.

Marraduke Ayscough Fawkes. Dated 4th February, 1942, with seniority from 20th December, 1940.

Anthony Maples. Dated 4th February, 1942, with seniority from 16th December, 1940.

Horace Williams. Dated 4th February, 1942, with seniority from 17th May, 1941.

Gerald Barwell. Dated 14th March, 1942, with seniority from 15th July, 1936.

#### LAND FORCES

##### To be Lieutenants (on probation)

Richard Augustine Johnson. Dated 16th March, 1941.

5th March, 1942

Francis Howard McCay.

Alexander Malcolm Kerr.

James Denis Clinton Currie. Dated 6th April, 1942.

#### (Emergency Commissions)

##### To be Lieutenants (on probation) for service in the Indian Air Force

6th March, 1942

Nariman Hormusji Oonvala.

Dossabhoy Bomanji Parakh.

Simadri Prasun Chatterjee. Dated 8th March, 1942.

Mihir Kumar Mitra. Dated 27th April, 1942.

#### INDIAN LAND FORCES

#### (Emergency Commissions)

##### To be Lieutenants (on probation)

Rustam Ardeshtir Davar. Dated 19th May, 1942.

Mallimadugula Venkata Ramanamurti. Dated 13th May, 1942.

#### LEAVE

Lieutenant-Colonel W. J. Webster, M.C., Assistant Director, Central Research Institute, Kasauli, is granted leave on medical certificate for 5 months, with effect from the 4th March, 1942.

#### PROMOTIONS

##### Captain to be Major

V. M. Albuquerque, M.B.E. Dated 5th June, 1942.

The undermentioned Captains (on probation) are confirmed in their rank, with effect from the date specified.

24th August, 1941

R. U. Qureshi.

W. A. C. Nason.

#### INDIAN LAND FORCES

#### (Emergency Commissions)

##### Lieutenants to be Captains

A. R. Biswas. Dated 25th March, 1941.

E. A. Ram. Dated 15th October, 1941.

M. C. Nath. Dated 24th August, 1941, with seniority from 14th June, 1941.

The undermentioned Lieutenants (on probation) are confirmed in their rank, with effect from the date specified :—

27th February, 1941

F. J. Bilimoria.

V. N. Khanna.

M. A. Khan.

R. S. Rao.

E. A. Ram. Dated 15th April, 1941.

M. C. Nath. Dated 14th June, 1941.

#### LAND FORCES

#### (Emergency Commissions)

R. A. Johnson. Dated 16th March, 1941.

6th August, 1941

A. B. Gilroy.

B. A. Lamprell.

O. J. S. Macdonald.

6th November, 1941

C. F. S. Alken.

T. M. B. Sloan.

#### RETIREMENTS

Lieutenant-Colonel N. S. Jatar, C.I.E., D.S.O., Inspector-General of Prisons, C. P. and Berar, has been placed on the retired list with effect from 26th May, 1942, and re-employed by the Provincial Government as Inspector-General of Prisons, C. P. and Berar, with effect from that date for a period of 2 years or until the end of the war whichever is earlier.

Lieutenant-Colonel M. A. Nicholson, C.I.E. Dated 10th June, 1942.

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## Original Articles

## QUININE DIURESIS IN MALARIAL CONDITIONS

By ROBERT HEILIG, M.D.

First Physician, Kriahmarajendra Hospital, and  
Professor of Medicine

and

VISWESWAR, M.B., B.S.

Research Scholar

Medical College, University of Mysore

SINCE the occurrence of malarial nephritis in India was reported and the excellent diuretic action of quinine in this condition was established (Heilig, 1941), ten more cases came under our observation, where quinine proved to be the only effective diuretic. As very little is known about the diuretic effect of quinine up to now, two different cases of this group may be described in some detail.

*Case 1.*—K. Gowda, a Vokaligar boy of 5 years, was admitted to the hospital because of a rapidly progressing swelling of the face, legs and abdomen, which had started some three weeks previously. Urine was said to be very scanty and high coloured. The father stated that the boy had suffered from attacks of rigor and fever at irregular intervals of two to three months for the past half a year; each attack lasted eight to ten days.

On examination the most striking features were œdema of the face, with swelling of the eye lids, severe œdema of penis, scrotum, abdominal wall and legs, pitting on pressure; the abdomen was protuberant due to a huge ascites, which everted the umbilicus. Clinically and radiologically the heart and lungs did not show any pathological signs, except for those due to the very elevated diaphragm. Pulse rate 120, blood pressure 110/70 mm. Hg. The liver was apparently not enlarged; the spleen seemed to be floating in the ascites, but the œdema of the abdominal wall prevented one from feeling it distinctly. Neurological signs were not elicited. The temperature was intermittent febrile, reaching 102° to 103° daily for three days, afebrile for one to two days, and rose again as before. A purulent discharge was noticed from the left nostril; the subsequent removal of the rhinolith had no influence on the fever.

Fundal examination : nothing abnormal.

Laboratory findings :

Urine :

|                  |    |           |
|------------------|----|-----------|
| Specific gravity | .. | 1032      |
| Albumin          | .. | +++       |
| Sugar            | .. | absent    |
| Urobilinogen     | .. | increased |

Microscopic :

|                 |    |     |
|-----------------|----|-----|
| Red blood cells | .. | ++  |
| Leucocytes      | .. | +   |
| Hyaline casts   | .. | ++  |
| Granular casts  | .. | +++ |

Culture : No growth.

*Motion* : Among six examinations (within two weeks), once a few hookworm ova were found.

*Blood* : Hæmoglobin 37 per cent (Sahli); urea—40 mg. per cent.; Wassermann, Kahn and Kline reactions—negative; malarial parasites—not found; malaria flocculation test—positive.

The patient was put on diuretic mixture, one ounce thrice a day. The diet consisted of milk and bread. After one week's treatment, the weight remained

unaltered, the general condition unchanged. Diuretic mixture was replaced by ammonium chloride, potassium acetate, gr. 10 each, three times a day; the latter was increased to gr. 15, thrice a day, the following morning. The weight was not reduced after five days of this medication; thyroid, gr.  $\frac{1}{2}$ , thrice a day, was added. In spite of all these efforts to diminish œdema and ascites by using all possible diuretics, the weight was 41½ pounds after two weeks of treatment—½ pound less than on admission. The general condition became unbearable; the boy could neither sit nor lie down; the general anasarca made every movement and every position equally impossible. An irregular, intermittent fever persisted. Albuminuria, hæmaturia and cylindruria increased.

The positive malaria flocculation test, the fever and the lack of response to any diuretic treatment, together with previous experiences in similar cases (Heilig, *loc. cit.*), induced us to start antimalarial treatment and to stop every other medication. The boy was put on quinine sulphate, gr. xv a day; the temperature became normal overnight and remained so for at least six weeks, the duration of observation. After three days, for the first time, the weight dropped to 39 pounds; the urine quantity increased slowly, the specific gravity diminished from 1030 to 1012. To speed up and to intensify the effect of the oral quinine medication one quinarsol injection (1 c.cm.) was given every day intramuscularly. The urine quantity increased from 300–600 to 1200 c.cm., the specific gravity varied between 1010 and 1014; within sixteen days of this treatment, the patient lost 15½ pounds = 35 per cent. of his body-weight, which was reduced from 41½ to 25½ pounds. Ascites and œdema disappeared entirely. The spleen became distinctly palpable, three-finger breaths below the left costal margin; subsequently its size diminished to one finger below the costal margin. The girth width diminished by 8 inches from 27.5 to 19.5 (table I). Hæmoglobin remained 38 per cent (Sahli); blood urea diminished slightly to 36 mg. per cent. The child which had refused to take any food before the antimalarial treatment, could not get enough to eat; it became bright and active. Three weeks after complete elimination of all the retained fluid and stopping of antimalarial treatment, carbon tetrachloride was given; two hookworms were passed. Subsequent examination of five motions on alternate days did not show any hookworm ova.

The observation in the hospital was continued for another week; during these four weeks after quinine treatment was stopped, the clinical improvement was fully maintained. The urine showed on repeated examination no pathological deposit; red blood cells and the very numerous casts had disappeared but albuminuria remained; this fact shows that, in spite of all the surprising success of the quinine treatment, a complete cure of the nephritis was not achieved.

*Case 2.*—Ch., a Hindu coolie, 28 years of age, was suffering from attacks of fever, preceded by rigors, for many months; each of those febrile periods lasted for 10 to 15 days and was separated from the next attack by an afebrile interval of two to three months. About



two months before admission, patient noticed swelling of the legs, which gradually increased; later on, the size of the abdomen increased to such an extent that he was hardly able to bind his dhoti. The fairly well built young man was moderately anæmic; the heart (clinically and radiologically) slightly enlarged; apex beat just inside the mid-clavicular line; a faint systolic

*Motion*: Hookworm ova present (a few).  
*Blood*: Hæmoglobin 23 per cent (Sahli); red blood cells—2.2 millions; urea—28 mg. per cent; van den Bergh—negative; Wassermann, Kahn, Kline reaction—negative; malaria parasites—not found; malaria flocculation test—positive; sedimentation rate—25/55.

TABLE I showing the progress in case 1

| Date | Weight, lb. | Girth, inches | URINE |                  | Treatment  |
|------|-------------|---------------|-------|------------------|--|
|      |             |               | c.cm. | Specific gravity |  |
| 1942 |             |               |       |                  |  |
| 13-1 | 41½         | ..            | 70    | 1032             |  |
| 14-1 | 41½         | ..            | 60    | 1030             |  |
| 15-1 | 41          | ..            | ?     | ?                | Mist. diuretica.   |
| 16-1 | 41          | ..            | ?     | ?                | " "  |
| 17-1 | 42          | ..            | 300   | 1020             | " "  |
| 18-1 | 42          | ..            | 120   | 1025             | " "  |
| 19-1 | 42          | ..            | 360   | 1021             | Ammon. chlor. and pot. acetat.                           |
| 20-1 | 41          | ..            | ?     | ?                | " " " " "  |
| 21-1 | 41½         | ..            | ?     | ?                | " " " " "  |
| 22-1 | 41½         | ..            | 300   | 1022             | " " " " "  |
| 23-1 | 41½         | ..            | 180   | 1024             | Ammon. chlor., pot. acetat and thyroid tab. gr. ½ t.d.s. |
| 24-1 | 42          | ..            | 60    | 1028             | " " " " " "  |
| 25-1 | 40½         | ..            | 120   | 1030             | " " " " " "  |
| 26-1 | 41          | ..            | 480   | 1022             | " " " " " "  |
| 27-1 | 41          | ..            | 600   | 1022             | All treatment stopped.                                   |
| 28-1 | 41½         | ..            | 600   | 1024             | Mist. quinine.   |
| 29-1 | 40½         | ..            | 360   | 1017             | " "  |
| 30-1 | 40½         | ..            | 690   | 1013             | " "  |
| 31-1 | 39          | ..            | 600   | 1015             | " "  |
| 1-2  | 39          | ..            | 1,200 | 1012             | " "  |
| 2-2  | 38½         | 27½           | 840   | 1014             | " quinarsol 1 c.cm. i.m.                                 |
| 3-2  | 37½         | ..            | 1,200 | 1011             | " " " " "  |
| 4-2  | 36          | ..            | 1,080 | 1014             | " " " " "  |
| 5-2  | 34½         | ..            | 1,200 | 1011             | " " " " "  |
| 6-2  | 33½         | ..            | 1,200 | 1011             | " " " " "  |
| 7-2  | 33½         | 23½           | 1,200 | 1010             | " " " " "  |
| 8-2  | 33          | ..            | 1,200 | 1011             | " " " " "  |
| 9-2  | 32½         | ..            | 840   | 1012             | " " " " "  |
| 10-2 | 31          | 19½           | 840   | 1014             | " " " " "  |
| 11-2 | 30¾         | ..            | 900   | 1012             | " " " " "  |
| 12-2 | 29½         | ..            | 600   | 1012             | " " " " "  |
| 13-2 | 28          | 19½           | 600   | 1012             | " " " " "  |
| 14-2 | 28          | ..            | 600   | 1010             | " " " " "  |
| 15-2 | 27½         | ..            | 480   | 1012             | " " " " "  |
| 16-2 | 26          | ..            | 480   | 1012             | " " " " "  |
| 17-2 | 26          | ..            | 480   | 1012             |  |
| 18-2 | 25½         | ..            | 480   | 1012             |  |

murmur was audible in the mitral and pulmonary auscultatory area; no accentuation of the heart sounds was present. Pulse rate 80; blood pressure 108/70 mm. Hg. Respiratory system did not show any pathological signs.

The abdomen was prominently protuberant; all signs of a large amount of free fluid were elicited. The liver was not palpable. The spleen reached one and a half hand breadths below the left costal margin and floated in the ascites. The pitting œdema of the legs extended from the ankles up to the thighs. Patient was afebrile during his whole stay at the hospital. Body-weight on admission 139 pounds.

#### Laboratory findings:

##### Urine:

|                   |    |                   |
|-------------------|----|-------------------|
| Specific gravity  | .. | 1031              |
| Albumin           | .. | slightly positive |
| Sugar             | .. | absent            |
| Urobilinogen      | .. | highly positive   |
| Bilirubin         | .. | absent            |
| Microscopically   | .. | nothing abnormal  |
| Bacteriologically | .. | no growth         |

To see whether the general anasarca could be reduced by rest and bread-and-milk diet the patient was kept under these conditions for six days; the only remedy which we gave were Bland's pills, gr. 90 per day; the weight was diminished only by 1½ pounds (139-137½). Diuretic treatment was started on the seventh day by giving, apart from the iron medication, ammonium chloride, gr. 45, and urea, drachms 15 per day; the diet consisted of milk and bread as before. Under this medication the patient's weight was reduced by 20 pounds, from 137½ to 117½, in thirteen days; in spite of the continuation of this treatment, the weight remained now constant for five days; neptal was injected; patient lost ten pounds in 24 hours and gained eight again (115 lb.) in the following five days, though the dosage of ammonium chloride was

increased to 75 grains and 2 ounces of urea were still given every day.

Meanwhile a hæmoglobin level of 45 per cent (Sahli) was reached; carbon tetrachloride was given; the patient passed some forty hookworms and none of the subsequent stool examinations showed any worm ova.

perature and the absence of a malarial nephritis; even the slight albuminuria had meanwhile subsided.

Patient received ten quinine injections intravenously (gr. 5, 7 and eight times gr. 10) on ten consecutive days, along with quinine sulphate orally, gr. 10 per day; the oral quinine

TABLE II showing the progress in case 2

| Date  | Weight,<br>lb. | URINE |                     | Hæmoglobin<br>percentage | Treatment                              |
|-------|----------------|-------|---------------------|--------------------------|--|
|       |                | c.cm. | Specific<br>gravity |                          |  |
| 1941  |                |       |                     |                          |  |
| 25-12 | 139            | 20    | 1028                | 23                       | Blaud's pill (continued up to 5-2-42). |
| 26-12 | 138            | 90    | 1031                | ..                       |  |
| 27-12 | 137            | 20    | 1030                | ..                       |  |
| 28-12 | 137½           | 300   | 1028                | ..                       |  |
| 29-12 | 138            | 300   | 1028                | 26                       |  |
| 30-12 | 137½           | 180   | 1029                | ..                       | Urea and ammon. chlor.                 |
| 31-12 | 136½           | 360   | 1026                | ..                       | " " " "                                |
| 1942  |                |       |                     |                          |  |
| 1-1   | 134            | 1,200 | 1023                | ..                       | " " " "                                |
| 2-1   | 131            | 1,200 | 1025                | ..                       | " " " "                                |
| 3-1   | 129            | 1,680 | 1027                | ..                       | " " " "                                |
| 4-1   | 128¾           | 1,080 | 1032                | ..                       | " " " "                                |
| 5-1   | 126½           | 1,200 | 1026                | 30                       | " " " "                                |
| 6-1   | 124¾           | 1,800 | 1030                | ..                       | " " " "                                |
| 7-1   | 123            | 1,500 | 1031                | ..                       | " " " "                                |
| 8-1   | 121            | 1,260 | 1031                | ..                       | " " " "                                |
| 9-1   | 120½           | 1,320 | 1032                | ..                       | " " " "                                |
| 10-1  | 119½           | 1,200 | 1031                | ..                       | " " " "                                |
| 11-1  | 117½           | 1,380 | 1029                | ..                       | " " " "                                |
| 12-1  | 117½           | 1,140 | 1013                | 34                       | " " " "                                |
| 13-1  | 118¾           | 960   | 1026                | ..                       | " " " "                                |
| 14-1  | 117½           | 1,200 | 1029                | ..                       | " " " "                                |
| 15-1  | 117¼           | 5,640 | 1009                | ..                       | Neptal, iv.                            |
| 16-1  | 107¼           | 1,140 | 1024                | ..                       | Urea and ammon. chlor.                 |
| 17-1  | 112            | 900   | 1030                | ..                       | " " " "                                |
| 18-1  | 113            | 1,200 | 1026                | ..                       | " " " "                                |
| 19-1  | 113¾           | 660   | 1027                | 45                       | " " " "                                |
| 20-1  | 114¾           | 960   | 1029                | ..                       | C.T.C. urea and ammon. chlor. stopped. |
| 21-1  | 115            | 720   | 1030                | ..                       | Quinine.                               |
| 22-1  | 114½           | 480   | 1034                | ..                       | "                                      |
| 23-1  | 115¾           | 420   | 1025                | ..                       | "                                      |
| 24-1  | 115            | 900   | 1025                | ..                       | "                                      |
| 25-1  | 113¾           | 1,080 | 1016                | ..                       | "                                      |
| 26-1  | 110            | 1,200 | 1015                | 45                       | "                                      |
| 27-1  | 108½           | 720   | 1019                | ..                       | "                                      |
| 28-1  | 107½           | 780   | 1024                | ..                       | "                                      |
| 29-1  | 106            | 960   | 1017                | ..                       | "                                      |
| 30-1  | 104½           | 1,200 | 1015                | ..                       | "                                      |
| 31-1  | 102½           | 690   | 1023                | ..                       |  |
| 1-2   | 101½           | 960   | 1018                | ..                       |  |
| 2-2   | 101            | 1,200 | 1016                | 50                       |  |
| 3-2   | 99½            | 960   | 1021                | ..                       |  |
| 4-2   | 100            | 840   | 1016                | ..                       |  |
| 5-2   | 98¾            | 450   | 1026                | ..                       |  |

Four weeks after admission, after three weeks of ammonium chloride-urea treatment, which had reduced the weight by twenty pounds but failed to reduce it further, even in spite of the use of neptal, the œdema of the legs had disappeared, but a marked ascites was still present. Because of the long history of previous fever attacks of apparently malarial origin, the large spleen and the positive malaria flocculation test, we decided to try quinine medication as diuretic treatment, in spite of normal tem-

perature and the absence of a malarial nephritis; during this treatment the urine quantity did not increase appreciably, as far as we could persuade the patient to collect the urine; but the specific gravity which was never lower than 1023 and mostly near 1030 during the previous diuretic treatment, dropped to 1015; the weight diminished by another sixteen pounds and was 99½ the last day of quinine treatment. The following week it varied between 98 and 100 pounds (table.II).

The ascites vanished to the last drop; the contour of the spleen could be seen through the abdominal wall, though its size was slightly diminished. The hæmoglobin which was 45 per cent before the antimalarial treatment was started, increased to 50 per cent (Sahli) on its termination.

### Discussion

To ascertain the diagnosis 'malarial nephritis' in case 1, we have only to exclude the hookworm infection as a cause of the general anasarca. It is beyond doubt that two hookworms do not produce any pathological signs, and certainly not such a marked fluid retention; hookworm disease never causes nephritis among our patients. A hæmoglobin content of 37 per cent (Sahli) never causes anasarca, even when such a hæmoglobin level is due to a hookworm infestation. Further, all the retained fluid was eliminated without any increase of hæmoglobin and before deworming; the anthelmintic treatment was performed three weeks after the antimalarial treatment was stopped and the presence of the hookworms did not prevent the achievement and the maintenance of the full clinical improvement. The absence of any other detectable ætiology of the subacute glomerulo-nephritis of the wet (or nephrotic) type, the excellent response to quinine treatment as far as fever, urine sediment and the total elimination of anasarca is concerned, taken together with the refractory response to any other diuretic treatment, make certain that malarial nephritis is the correct diagnosis.

The analysis of case 2 shows that the general anasarca in this case was due to two different factors. The one responded to ammonium chloride *plus* urea, given simultaneously in large doses; this medication was found to be the most effective diuretic treatment in anasarca due to hookworm disease (Heilig, *loc. cit.*). Twenty pints of œdema fluid were eliminated by those diuretic remedies. Was this part of the general anasarca due to the hookworm infestation? It is possible. The hæmoglobin value on admission was 23 per cent (Sahli) and increased to 45 per cent along with the reduction of the œdema; but in spite of the normalized blood condition, almost one-half of the retained fluid remained uneliminated; the ascites hardly diminished, in spite of the most intensive use of diuretics, mercurials included. And finally, the result of deworming proved that the hookworm population was very scanty, hardly sufficient to cause such a hypoproteinæmia that general anasarca should be its consequence. Whether we call the œdema producing factor, which yielded to ammonium chloride *plus* urea, ancylostomiasis or an unspecified toxin which increased the permeability of the capillaries and was responsible for the appearance of œdema in the legs, the other factor was related to chronic malaria and

maintained the ascites practically undiminished. The weight chart shows that but for the use of large doses of quinine, applied by intravenous and oral routes, the peritoneal effusion of this man seemed refractory to any treatment; he would have been one more of those unfortunate cases, frequently found in this part of the country, for whom tapping of the abdomen in shorter and shorter intervals brought the only possible relief. It is impossible, at present, to state definitely how the antimalarial treatment caused the elimination of the ascitic fluid. The fact that fever attacks of definite malarial origin occurred up to two months before the patient came to the hospital, shows that the irreversible fibrotic changes which develop in the spleen of chronic malaria cases had not much time to develop. The reduction of the size of the spleen which was noticed under the course of quinine is a further proof that the malarial changes were partly reversible. It is not far-fetched to assume that with the reduced volume of the spleen, the intra-abdominal pressure and especially the impairment of the portal circulation diminished to such an extent that a resorption of the effusion became possible. Considering the frequent incidence of cases with ascites, collateral circulation and large spleen among our patients, cases which do not belong to Banti's disease as no hæmatemesis ever occurs, it is of the greatest importance to stress their malarial origin, as early antimalarial treatment saves them; whereas later on, when the enlargement of the spleen has become permanent due to the development of the firm connective tissue, spreading to and obstructing the portal branches, no treatment is of any avail.

The literature on malarial nephritis was ably surveyed by Giglioli (1930). Working in British Guiana, he found that kidney complications in malaria are almost specifically connected with *Plasmodium malariae*; that is also the experience of Clark (1912), regarding nephritis in Malaya, and the opinion held by Manson-Bahr who with Maybury (1927) reported two cases of nephritis, accompanying quartan malaria. In India, malarial nephritis was apparently not observed prior to the report from Mysore (Heilig, *loc. cit.*), though temporary albuminuria was noticed, 'especially towards the end of febrile paroxysms' (James, 1922) and ascribed partly to the use of quinine and alkaline mixtures (Sinton and Lal, 1924). However, the opinion that malarial kidney affections are practically confined to areas where quartan malaria is predominant is definitely at variance with our local experience; quartan malaria is a rarity among our patients and apart from one case, mentioned previously (Heilig, *loc. cit.*), no suspicion of *Plasmodium malariae* infection was substantiated from the history of our patients; when malarial parasites were actually found, they were *Plasmodium vivax*. The same

fundamental difference as between the ætiological factors is found in the therapeutic response. Manson-Bahr and Maybury and Giglioli seem to be the only modern authors who treated malarial nephritis with quinine; they are agreed upon the excellent effect of it on the nephritis and its manifestations (blood urea); but regarding the œdema in acute and subacute cases of wet type, Giglioli recommends the use of urea; he does not mention the diuretic effect of quinine anywhere. In chronic cases he found antimalarial treatment useless. We, on the other hand, emphasize that quinine is not only indicated in every renal affection, acute or subacute, which accompanies acute or subacute malarial conditions, the latter characterized by an occasional fever attack with long afebrile periods, but also where there was no sign of activity of the malarial process detectable. In cases where nothing but the large spleen and mostly, though by no means always, a positive malaria flocculation test point towards the malarial origin of ascites or general anasarca, a course of intensive quinine treatment with maximal doses should be started immediately. Case 2, reported above, is one of eight where not the slightest rise of temperature was noticed during weeks of observation; to base on afebrility the assumption that antimalarial treatment should not be tried is wrong; the same case shows also that quinine might act as a most potent diuretic in apparently chronic malarial affections with ascites and without any sign of nephritis, cases which are usually labelled as malarial cachexia or malarial cirrhosis (?) and which are hardly ever treated as malaria.

### Conclusion

Under local conditions malarial nephritis occurs as a manifestation of benign tertian malaria; it is in no way bound on the distribution of *Plasmodium malariae*. It is encountered as an acute or subacute glomerulo-nephritis, wet or nephrotic type. Apart from these renal forms or complications of malaria, cases are seen of apparently inactive (chronic) malaria, characterized by a very considerable enlargement of the spleen, malaria flocculation test frequently positive and a huge ascites or general anasarca without signs of renal damage. In all these manifestations of malaria, quinine in full doses (preferably as an intravenous injection) is clearly indicated; it acts in most of these cases as a powerful diuretic, superior to all other diuretic remedies, which we had tried prior to its application; in some of these conditions of malarial dropsy it is the only effective diuretic. Though we do not assert that the cases of subacute nephritis or those of a late malarial ascites are cured by this treatment, the clinical improvement is so considerable that every patient of this kind should be given this chance.

(Concluded at foot of next column)

## DIAGNOSIS AND PATHOLOGY OF TRACHOMA IN INDIA

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THE following investigation was done as a preliminary measure in an attempt at assessing the percentage of trachoma in Delhi's school population by the rapid examination of school children. It is now published in the hope that the information gained may be of use in the rapid estimation of trachoma in the examination of recruits. The routine practised in the schools was simply examination of the cornea and the lid conjunctiva after eversion of the lids in good daylight, or artificial light, with the aid of a binocular loupe or prismospheres. In the thirteen cases which were fully investigated, naked-eye examination was followed by examination of the conjunctiva and cornea with the slit lamp and corneal microscope. This in turn was followed by examination of an epithelial scraping from the upper fornix. Finally, biopsy was done on a specimen of conjunctiva snipped off the outer third of the upper fornix. This

(Continued from previous column)

### Summary

One case of malarial subacute glomerulo-nephritis, nephrotic type, and one of general anasarca in an old afebrile malaria are reported in some detail. In both of them quinine, given in massive doses, was found to exert a diuretic action, superior to all other diuretic remedies administered in these cases.

These experiences are compared with those previously published.

Our thanks are due to Dr. J. F. Robinson, B.A., M.D., F.A.C.S., F.R.C.S.E., Medical Officer, Krishnarajendra Hospital, and Principal, Medical College, University of Mysore. Experience of many years in this country taught him that quinine treatment may yield most unexpected success in nephritis, whenever a malarial infection—even without any obvious sign of activity—is present; this experience gained by him stimulated our investigations.

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site was chosen as one of the writers (R. E. R. M.) has come to the conclusion, after many slit-lamp examinations of trachomatous eyes, that trachoma remains active longest in the outer third of the upper fornix. Examination of these sections of conjunctiva led to the desire to follow the disease into the tarsal plate, and in part II of this paper one of us (M. K. B.) has described the findings in trachomatous conjunctiva and also in deformed tarsi removed in cases of advanced cicatrization.

appearance may look like 'roughening' of the conjunctiva before this stretching test is applied. A positive result on stretching is tabulated in column IV as 'granules on compression'. In column V the presence of fibrotic network, stars, and Arlt's line are classified as 'fibrosis'. The last step in the naked-eye examination was to investigate the cornea after the lids had been replaced and the upper lid drawn up by thumb pressure upwards on the eyebrow. These findings are noted under three headings: (a)

## PART I

TABLE I

| Number | CONJUNCTIVA OF UPPER LID |             |                     |                         |          | CORNEA     |         |                | SLIT-LAMP EXAMINATIONS   |  |
|--------|--------------------------|-------------|---------------------|-------------------------|----------|------------|---------|----------------|--|--|
|        | Congestion               | Hypertrophy | Projecting granules | Granules on compression | Fibrosis | Broadening | Vessels | Herbert's pits | Conjunctiva  | Cornea   |
| 1      | +                        | +           | -                   | +                       | +        | +          | -       | +              | Gelatinous area and granules. Patches of oedematous network. Much fibrosis.                                      | Long vessels. Infiltration. Pits.                                  |
| 2      | -                        | +           | -                   | ?+                      | -        | ?+         | -       | -              | Snowy honey-comb. Occasional large granules.   | Superficial infiltration and pigmentation. Vessels not lengthened. |
| 3      | -                        | +           | -                   | +                       | +        | +          | -       | +              | Gelatinous areas and much fibrosis.  | Long vessels. Infiltration. Pits.                                  |
| 4      | +                        | +           | -                   | -                       | -        | +          | -       | -              | Gelatinous honey-comb.   | Long vessels. Round maculae. Pigmentation.                         |
| 5      | +                        | +           | -                   | -                       | ?+       | -          | -       | -              | Gelatinous thickening. Oedematous network.   | Short vessels. Pigmentation.                                       |
| 6      | +                        | +           | -                   | +                       | -        | +          | -       | -              | Honey-comb, ill-marked fibrotic stars. Occasional gelatinous granule.  | Much infiltration. Long vessels. One limbal granule.               |
| 7      | +                        | ++          | +                   | +                       | -        | +          | +       | +              | Large granules with yellow infarcts (fatty degeneration). No fibrosis.   | Long full vessels. Infiltration. Pits.                             |
| 8      | +                        | +           | +                   | +                       | -        | ?+         | -       | -              | Large translucent granule. Very congested honey-comb.  | Long vessels and much infiltration.                                |
| 9      | -                        | +           | -                   | +                       | -        | ?+         | -       | -              | Mainly snow-white honey-comb. Outer third red and oedematous.  | Vessels and infiltration but not extensive.                        |
| 10     | -                        | +           | -                   | +                       | +        | +          | -       | +              | Honey-comb with large tufts—oedematous papillary in outer third. Occasional gelatinous granule.                  | Long vessels. Superficial infiltration. Pits.                      |
| 11     | -                        | +           | -                   | ?+                      | -        | -          | -       | -              | Oedematous papillary appearance with white honey-comb in centre. A few gelatinous granules.                      | Long vessels. Infiltration in form of many maculae.                |
| 12     | +                        | +           | +                   | +                       | -        | ?+         | -       | -              | Honey-comb with fading tufts. Raised amyloid network.  | Long vessels. Superficial and gelatinous looking infiltration.     |
| 13     | -                        | +           | -                   | +                       | +        | ?+         | -       | -              | Honey-comb still vascular. Oedematous in outer third. Occasional gelatinous granule, well-marked fibrotic bands. | Long full vessels. Infiltration.                                   |

In table I the first two columns show the findings on naked-eye examination after eversion of the lids. The presence of obvious granules is noted in column III. With the upper lid still everted the thumb was placed behind the everted tarsus which was then stretched on the thumb nail. Small granules otherwise invisible were demonstrated in this way, also fine fibrotic markings between the granules. To the naked eye this

broadening of the limbus, (b) vascularization, (c) presence of Herbert's pits or actual granules.

The terminology used in recording slit-lamp findings is probably rather personal to the author (R. E. R. M.) and so requires elucidation. Granules or follicles are easily recognized, their colour varying from grey to amber translucency and occasionally a fatty yellow. In earlier cases each future follicle is represented by a

TABLE II

| Number | Presence of inclusion bodies in epithelial scraping | Report on section  |
|--------|---|--|
|        | Giemsa  |  |
| 1      | Green granules and plasma cells.                    | Epithelial hyperplasia. Sub-epithelial lymphocytic infiltration. No follicles.   |
| 2      | ..  | Epithelial hyperplasia only.   |
| 3      | ..  | Papillary epithelial hyperplasia. Mast cells ++. Epithelial cysts. Fibrotic nodule.  |
| 4      | Green granules.                                     | A few accumulations of lymphocytes. Fibrotic nodule.   |
| 5      | ..  | Epithelial hyperplasia. No follicles. Scanty new fibrous tissue.   |
| 6      | ..  | Irregular hyperplasia of epithelium. Much fibrosis. Mast cells numerous. Large follicles.  |
| 7      | ..  | Irregular hyperplasia of epithelium. Generalizes sub-epithelial infiltration. A few follicles. Early fibrosis. Epithelial cysts.                               |
| 8      | ..  | Papillary hyperplasia of epithelium. Large follicles. Mast cells in fibrous cone of nodule. Tendency for formation of fibroblasts at periphery of nodules.     |
| 9      | ..  | Papillary hyperplasia of epithelium. Sub-epithelial lymphocytic infiltration. Deep fibrous tissue. One fibrous nodule.   |
| 10     | ..  | Papillary hyperplasia of epithelium. Sub-epithelial lymphocytic infiltration. Lymphoid follicles. Tendency to epithelial cysts. Fibrous tissue present.        |
| 11     | ? initial body.                                     | Irregular hyperplasia of epithelium. Polymorphs in epithelium. Sub-epithelial infiltration. Small epithelial cysts.  |
| 12     | ..  | Hyperplasia of epithelium. Sub-epithelial lymphocytic infiltration. Loose fibrosis.  |
| 13     | ..  | Hyperplasia of epithelium with slight degree of papillary hypertrophy. Sub-epithelial lymphocytic infiltration. No follicles. Early fibrosis. Many mast cells. |

'tuft', a small vertical plume of vessels. In comparison, the infiltrated conjunctiva between the tufts appears as a paler honey-comb. Fresh tufts are pink, succulent, very definitely raised, and close together. They are difficult to isolate as separate eminences and are here put under the name of 'œdematous network'. The tissue between the tufts in other cases becomes whiter and more opaque, and in this form may be called 'amyloid honey-comb'. Later still, when the tufts atrophy the honey-comb becomes denser and whiter, 'snowy honey-comb'. Last of all cicatrization is seen as a condensation of this network, in other cases as star formations of fibrous tissue which appear to be superficially placed and are probably in the conjunctiva rather than the tarsus.

TABLE III

Out of 13 cases :

- (a) 7 have congestion of the lid conjunctiva.
- (b) All 13 show hypertrophy.
- (c) 3 have obvious granules.
- (d) 9 have granules on compression.  
2 are doubtful as to the presence of granules on compression.  
2 have no granules on compression.
- (e) 12 have elongation of limbal vessels.
- (f) 12 have pathological changes which may be accepted as characteristic of trachoma.

Of the two cases which have no granules on compression, one (case 4 in table I) shows congestion and hypertrophy of the upper fornix and broadening of the limbus. In the slit-lamp report on this case, only gelatinous honey-comb and long vessels on the cornea are visible. However, these vessels may be accounted for by the presence of a macula. The pathological report, a few accumulations of lymphocytes and one fibrous nodule, is also not conclusive regarding the presence of trachoma. In the second of these two cases, case 5 in the table, there are no corneal signs in either the naked-eye and slit-lamp reports, and there is doubt also in the pathological report where no mention is made of sub-epithelial hypertrophy or nodules. If the combination of pannus, epithelial hypertrophy, and sub-epithelial lymphocytic infiltration of the conjunctiva is taken as positive proof of the presence of trachoma, then in this series of thirteen cases of hypertrophy of the fornix twelve are definitely trachomatous. Three only of these thirteen have obvious granules visible on ordinary eversion of the upper lid, while eleven show granules by compression.

#### Conclusion

Stretching of the everted upper lid is of help in the routine diagnosis of trachoma.

#### PART II

That different types of trachoma may exist in different parts of the world has been suggested. It has been stated, for example, that in American Indians the predominating cell in the trachoma follicle is an epithelioid cell, whereas in Europe and Egypt the lymphocyte and plasma cell predominate, with a few epithelioid cells in old cases (May, 1928). It has also been said that in some countries a form of trachoma may occur in which lymph follicles are never observed, but instead a generalized sub-epithelial infiltration with lymphocytes (MacCallan, 1936).

As there is no record of the histopathology of trachoma as seen in this country, it was decided to study a number of consecutive cases, in order to ascertain what were the predominating features and to note what difference, if any, existed in the histology of trachoma as seen in the north of India and that described by workers in other parts of the world.



The most easily available material for the investigation was the upper tarsal plate, excised at operation for the correction of entropion and trichiasis, and specimens of lacrimal sac, removed for dacryo-cystitis associated with trachoma. More recently biopsies from the conjunctiva have been examined in order to ascertain the earlier changes.

**Material.**—Thirteen tarsi, classified clinically according to MacCallan's classification as trachoma III and IV, were examined, as well as eight specimens of lacrimal sac.

**Methods.**—The specimens were fixed in 5 per cent formal saline, embedded in paraffin and stained with hæmatoxylin and eosin for general structure, with van Gieson's stain for fibrous tissue, with a modification of Giemsa's method for inclusion bodies and mast cells. In a few cases carbol thionin (modified technique) was employed for rickettsia, and toluidin blue for the heparin granules of mast cells.

The tarsi were cut parallel with the lid margin and included the conjunctiva. The upper eyelid of a still-born infant was removed and sectioned in the same way, in order to compare the normal tarsus, before changes secondary to outside stimuli of mechanical or infective nature might occur. A tarsus was also removed *post mortem* from an adult in whom no disease of the eye was manifest. This served as a comparison of a normal tarsus which had come into contact with the usual irritation and infections to which the conjunctiva is exposed during life. Photomicrographs of these two tarsi and a trachomatous tarsus were taken, in order to illustrate the gross changes in the tarsus.

**Gross changes.**—The marked increase in thickness due to hyperplasia of the conjunctiva epithelium, infiltration with chronic inflammatory cells and the formation of new fibrous tissue is well illustrated in photo 1. The presence of a lymphoid follicle seen on the right would seem to indicate that the disease is still active in this case. The distortion of the tarsus due to cicatricial contraction is evident. Photo 2 is a section of a lacrimal sac, showing a large lymphoid follicle projecting into the cavity of the sac. A generalized thickening of the wall of the sac can be seen in this photograph.

**Detailed histology.**—In all the specimens examined profound changes were noted and will be described in detail under separate headings.

1. Epithelial layer.
2. Sub-epithelial layer.
3. Tarsus proper including Meibomian glands.
4. Blood vessels.

1. **Epithelial layer.**—Obvious disturbance of the tarsal conjunctiva was found in all cases. Some specimens showed a marked epithelial hyperplasia, with a stratified arrangement, and flattening of the surface layer, others showed a flattened epithelium with only a few layers, and in some cases only one layer in thickness, while yet another variety was a papillary formation

with strands of epithelium penetrating deep into the sub-epithelial layer and the formation of epithelial cysts. All of these changes might be found in one and the same tarsus representing no doubt different stages of the disease. The changes correspond on the whole with the description given by Lamb (1935). The lining epithelium in the specimens of lacrimal sac showed a similar type of change. In these, however, the cells were columnar, much mucoid degeneration was present and many goblet cells were seen. Cysts formed by down growths of epithelium and the glueing together of the opposing surfaces of epithelium could be clearly made out (see photos 3 and 4). These epithelial cysts were very numerous in some specimens of tarsus and were relatively large; the lining epithelium was often several layers thick, but sometimes was composed of a single flattened layer. In some cases these cysts could be seen quite deep in the tarsus with no apparent connection with the surface and often showing degenerative changes. They were, however, always situated superficial to the Meibomian glands, i.e., nearer the conjunctiva, and were quite different in appearance from retention cysts of those glands. The latter were more discrete and showed no encircling inflammatory reaction, while the epithelial cysts were generally surrounded by a dense small round cell infiltration (see photos 5 and 6). These are what Michail describes as intra-tarsal epithelial cysts.

2. **Sub-epithelial layer.**—In all cases a generalized sub-epithelial infiltration with lymphocytes and plasma cells was present. This varied in intensity from specimen to specimen and from one part of a specimen to another. Such cells were found to aggregate around epithelial cysts, to form dense clumps or definite lymphoid follicles. The follicles were composed of large cells with pale nuclei (lymphoblasts) in the centre and, towards the periphery, small lymphocytes and plasma cells. A few phagocytic giant cells (Leber cells) could usually be detected in the centre (photo 7). In many cases numerous fibroblasts were present, and a gradual replacement of inflammatory cells by fibrous tissue was apparent. These changes are essentially the same as those described by Wilson (1932) in Egypt and by Michail and others.

3. **The tarsus proper.**—Acini of Meibomian glands unaffected by any inflammatory change were seen in some parts of most tarsi. Scanty lymphocytic infiltration was seen in connection with these glands. The chief change was hyperplasia of the lining epithelium of the ducts and glandular acini. It was obvious in some specimens that the changes first appeared in the ducts, as the ducts showed early hyperplasia while the glands were still normal. In advanced cases ducts were seen obliterated by these cells and glandular acini entirely replaced by them, often with central cystic degeneration (photos 8 and 9). The end results appeared to be either

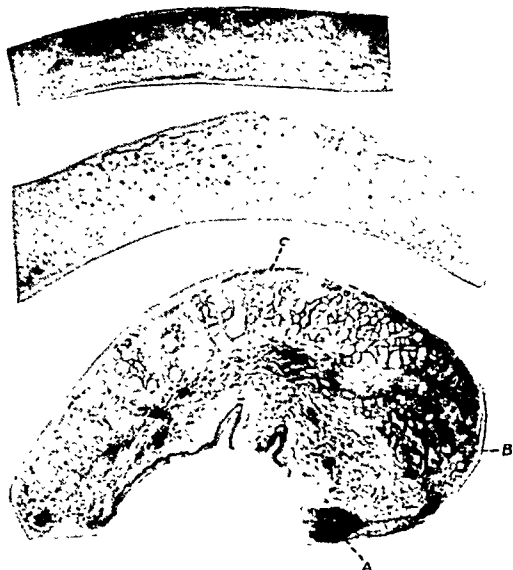


Fig. 1.

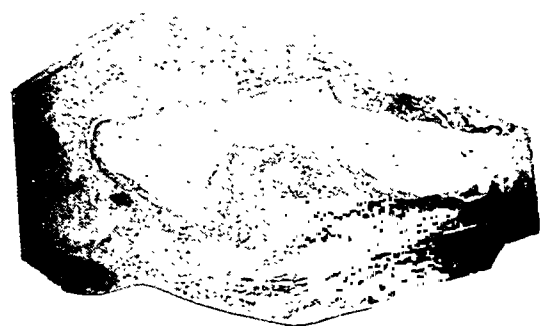


Fig. 2.

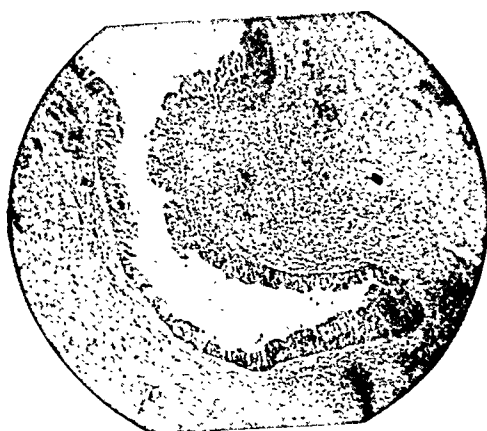


Fig. 3.

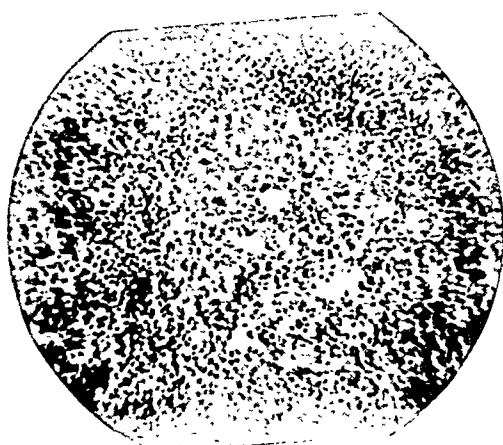


Fig. 7.

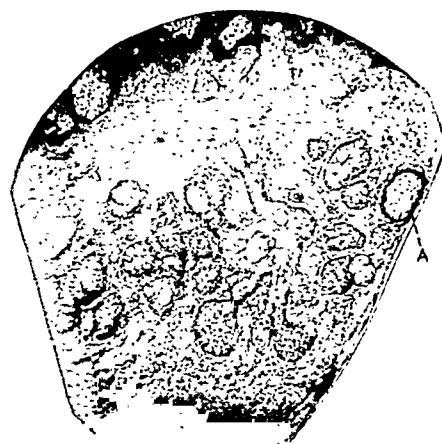


Fig. 8.



Fig. 9.

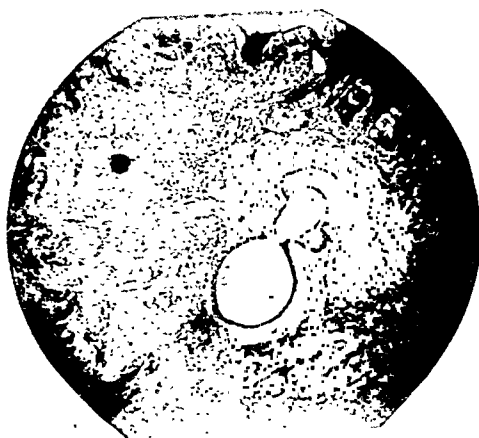


Fig. 10.

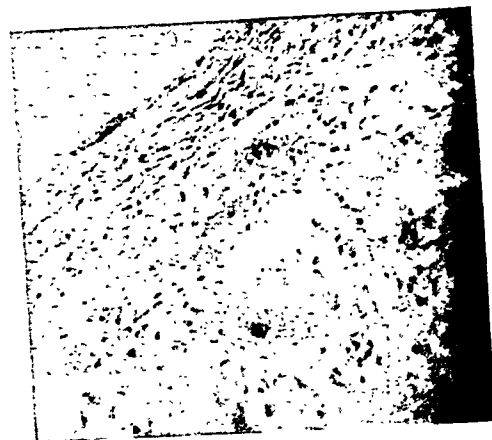


Fig. 11.



Fig. 4.

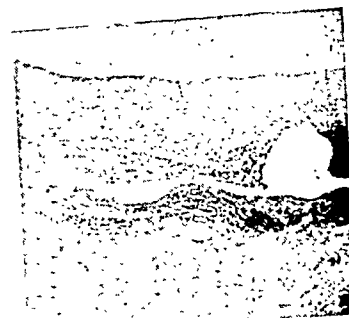


Fig. 5.



Fig. 6.

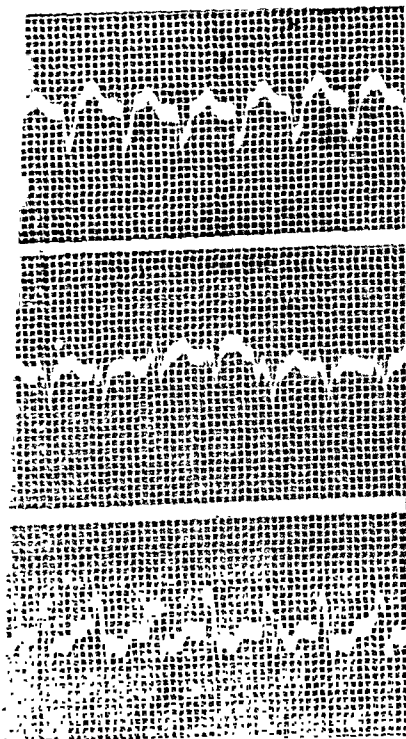


Fig. 1.—Electrocardiogram taken during an attack of paroxysmal tachycardia. Rate of heart: 200 per minute. The individual complexes display notching and a diphasic character. (Date of tracing: 14-4-40.)

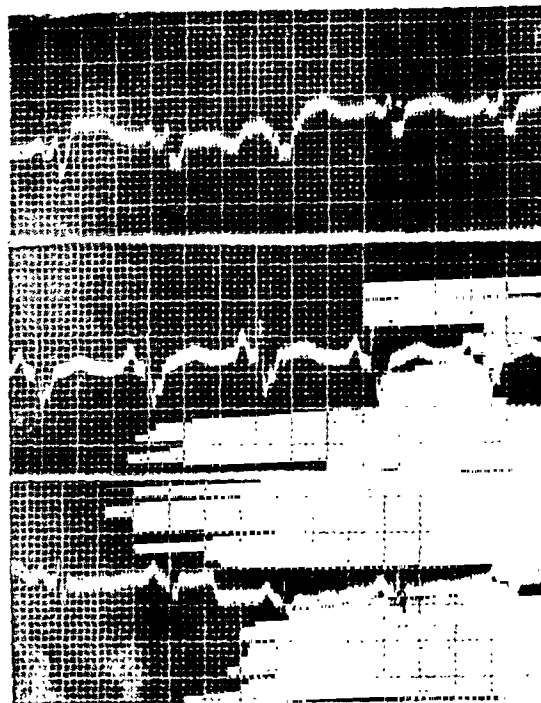


Fig. 2.—Electrocardiogram, showing apparent bundle branch block with short P-R interval, wide QRS complexes and shrunken and notched S deflections. (Date of tracing: 15-4-40.)

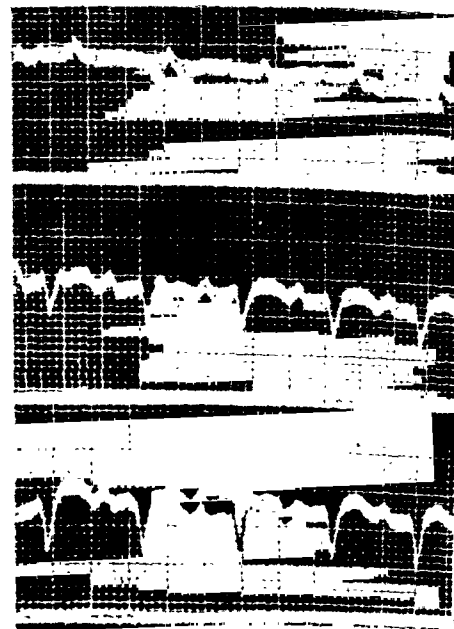


Fig. 4.—4-lead electrocardiogram taken a few hours before death, showing monophasic downward deflections in leads 2, 3 and 4 with 'doming' of S-T and flattening and inversion of the T waves. The duration of P-R has increased to 0.22 sec. (Date of tracing: 31-7-40.)

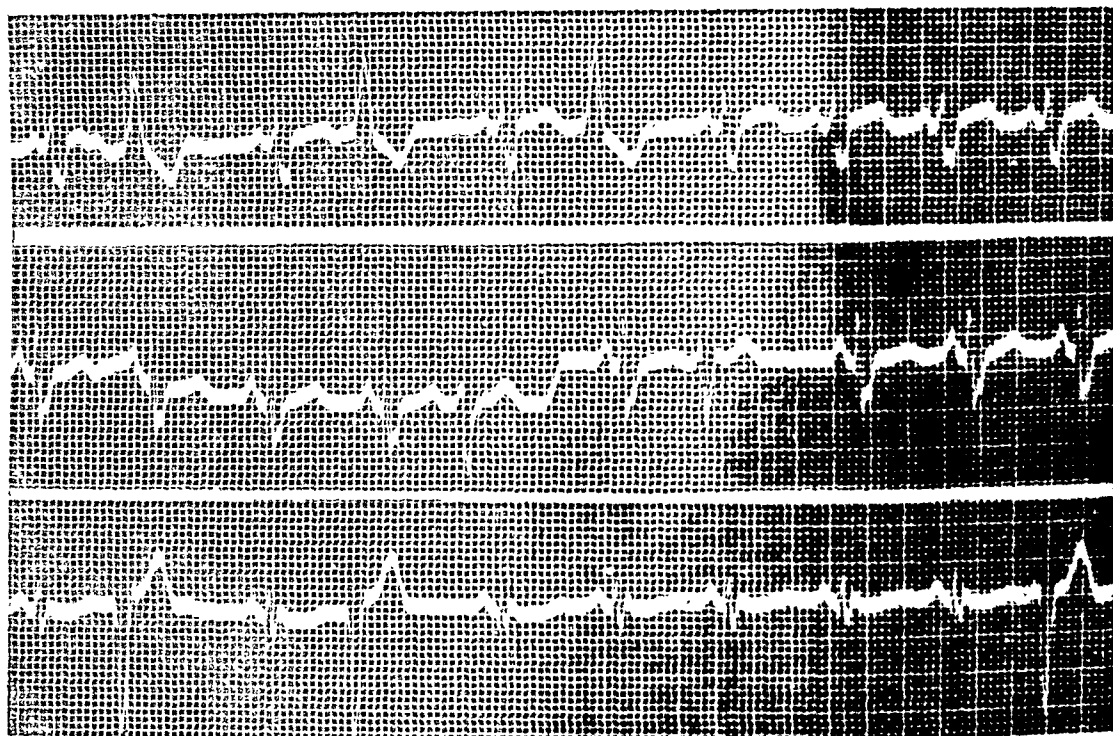


Fig. 3.—Electrocardiogram, showing apparent bundle branch block (right-sided) and ventricular extra-systoles. The short duration of P-R and the widening of the QRS complexes are characteristic. (Date of tracing: 22-4-40.)

retention cysts (photo 10) or obliteration of the glands, the new cells having been gradually replaced by fibrous tissue. In a few cases calcification of acini was seen to have occurred. This epithelioid infiltration of acini and ducts has not been described elsewhere. MacCallan (1936) states that the inflammation of the sub-epithelial tissue leads to blockage of the ducts of sebaceous or Meibomian glands, either by cell pressure or by cicatrization, but it would appear in this series that the ducts are blocked more often by a proliferation from inside the duct than from outside pressure or contraction.

4. *Blood vessels.*—The condition of the blood vessels varied considerably according to the stage of reaction present. In some cases numerous large dilated vessels were seen, in or deep to the sub-epithelial layer, in some numerous fine capillaries, close to the conjunctiva and in association with the follicles predominated. When much infiltration with small round cells was present the vessels were noted to have a hyperplastic endothelium, while in the cicatricial areas an obliterated process appeared to be occurring.

*Further points of note.*—In the Giemsa-stained sections, degenerative changes in the cytoplasm of the epithelial cells, and the cells in the lymph follicles, with much scattered cellular debris forming irregular granules of varying sizes between and inside cells, were a prominent feature. The enormous number of tissue mast cells present was also noteworthy. These were present where fibrous tissue was abundant and in approximation to the walls of blood vessels. Few were seen in follicles, and practically none in the epithelial layers or in the glands (photo 11). The presence of these cells in chronic inflammatory conditions including trachoma, and to a lesser degree in connective tissue generally, has been noted by various observers. J. E. Jorpes (1939), in discussing the chemistry and physiology of heparin, produces evidence to show that the basophil granules of mast cells constitute the anti-coagulant heparin, and can be stained specifically by toluidin blue. For this reason some of the sections were stained with toluidin blue and it was found that the mast cell granules, which were so prominent when stained by Giemsa, were also stained by toluidin blue and presumably therefore represent heparin. In tissues where cell disintegration is so notable a feature, the presence of large amounts of available heparin suggests that its function may be that of neutralizing the kinase liberated by cell disintegration, and the consequent prevention of coagulation of tissue fluids.

No Halberstaeder-Prowaczek bodies were detected in these sections, and no rickettsia.

#### Summary

The histology of specimens of tarsus and lacrymal sac, infected with trachoma, is described.

(Concluded at foot of next column)

## A CASE OF MITRAL STENOSIS WITH APPARENT BUNDLE BRANCH BLOCK, SHORT P-R INTERVALS AND ATTACKS OF PAROXYSMAL TACHYCARDIA

(THE WOLFF, PARKINSON AND WHITE SYNDROME)

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THE following case is presented because of its apparent rarity and for the unusual electrocardiographic pictures it presents.

(Continued from previous column)

The main features are :—

1. Epithelial hyperplasia with formation of epithelial cysts.
2. Sub-epithelial lymphocytic infiltration both diffuse and aggregated into follicles, often with definite germinal centres.
3. Epithelioid hyperplasia in Meibomian glands and cyst formation.
4. Cellular degeneration and the presence of large numbers of tissue mast cells.
5. No Halberstaeder-Prowaczek bodies were detected.

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#### DESCRIPTION OF PLATE XVI

- Fig. 1.—Adult tarsus (without skin). Infant's tarsus (skin included). Trachomatous tarsus.  $\times 9$ .  
a = Lymph follicle.  
b = Epithelial cysts.  
c = Retention cysts of Meibomian glands.
- Fig. 2.—Lacrima sac.  $\times 9$ . Note lymph follicle and cyst lined columnar epithelium.
- Fig. 3.—Lacrima sac.  $\times 50$ . Note infiltration with small round cells and hyperplasia of epithelium. Opposing surfaces of mucous membrane approaching.
- Fig. 4.—Epithelial cyst formation in lacrima sac.  $\times 50$ .
- Fig. 5.—Epithelial cyst and stratified type of conjunctiva. Note small strand of epithelium connecting cyst with conjunctival epithelium.  $\times 50$ .
- Fig. 6.—Epithelial cyst.  $\times 100$ .
- Fig. 7.—Lymphoid follicle.  $\times 225$ . Seen in wall of lacrima sac.
- Fig. 8.—a = Normal glandular acinus. Meibomian glands showing epithelial hyperplasia in ducts and acini.  $\times 50$ .
- Fig. 9.—Epithelial hyperplasia in duct of Meibomian gland.  $\times 100$ . a = Normal gland.
- Fig. 10.—Retention cyst of Meibomian gland.  $\times 50$ .
- Fig. 11.—Mast cells stained with Giemsa's stain.  $\times 100$ .

### Case Report

Mrs. D., a Khoja lady, aged 39, was first seen on 14th April, 1940, with a history of severe palpitation and shortness of breath of five days' duration. She had been in perfect health till 1935, when she had a similar attack of palpitation and dyspnoea lasting for two days. After the attack in 1935, she had an electrocardiogram taken; this showed widened QRS complexes with broadening and slurring of the S waves and frequent ventricular extra-systoles; in fact, the old electrocardiogram was identical with the recent tracing taken on 22nd April, 1940. A teloradiogram taken in 1935 showed a normal sized heart with some prominence of the pulmonary conus. Though she had suffered from vague aches and pains in childhood, there was no history of rheumatism.

She developed her second attack of palpitation quite suddenly on the 9th April, 1940, while attending to her household duties and in apparently the best of health. Besides severe palpitation and a feeling of 'fluttering' in the chest, there was throbbing in the neck, a feeling of faintness and exhaustion, profuse sweating and difficulty in breathing. Two days later, she developed abdominal discomfort with pain in the right hypochondrium. She was given large doses of digitalis by her attending physician.

When seen by me for the first time on 14th April, 1940, the patient was intensely dyspnoeic and lay supported in the semi-recumbent position with pillows. The face was drawn and pale, while large beads of perspiration were visible on her forehead and face. Cyanosis was apparent in the ears, lips and nose. There was slight oedema of the ankles and definite puffiness of the lower eyelids. In the neck, prominent and obviously distended jugular veins were pulsating vigorously. The pulse rate was too rapid to count.

The cardiac impulse was diffuse and forcible, the apex beat being in the 5th space,  $4\frac{1}{2}$  inches from the mid-line. The heart rate determined at the apex was about 200 per minute (?). The heart sounds were almost 'tic-tac'. The liver was palpable and tender and crepitations were audible at both lung-bases.

An electrocardiogram (figure 1) taken during the attack was suggestive of paroxysmal ventricular tachycardia, with a heart rate of 198 per minute.

She was given 25 c.c. of 25 per cent glucose intravenously and 6 grains of quinidine sulphate. Within two hours, the rate had fallen to 120 per minute. The quinidine was continued in 3-grain doses for a week or more. The paroxysm had lasted exactly six days.

Next morning, the patient's general condition was found to be considerably improved. The heart was 96 per minute and regular. There was a short rough presystolic murmur just inside the apex, and a soft blowing systolic murmur over the left half of the præcordium; the second sound at the base was duplicated.

An electrocardiogram (figure 2) taken one day after the termination of the attack showed the following features: (1) A heart rate of 97 per minute, quite regular; (2) large P waves with a short P-R interval, duration of P-R being 0.10 to 0.12 secs.; (3) wide QRS complexes, duration of QRS being 0.14 sec.; (4) prominent and wide S deflections with marked notching and slurring; the S wave duration in lead 2 was 0.09 sec. The R waves were small in all leads.

Another electrocardiogram (figure 3) taken a week later showed the same sort of picture except for the frequent occurrence of ventricular extra-systoles. The latter showed a tendency to occur alternately with normal beats for two to four cycles and then to disappear completely for five to seven cycles.

The patient was soon on her legs again and carried on with her usual household duties. She could walk about with little or no dyspnoea and the oedema had practically disappeared.

On the evening of 25th July, 1940 (that is, three months after the attack of paroxysmal tachycardia), the patient while in the bathroom suddenly experienced

an attack of intense dyspnoea, palpitation and faintness. When seen by me two days later, she was intensely breathless and tossing about in bed, literally gasping for breath. She complained bitterly of nausea and vomiting. The urinary output had fallen to about 2 or 3 oz. a day. The extremities were cold and clammy, the face had a 'cadaveric appearance' and the pulse could not be felt. No sounds were audible to auscultation during blood pressure estimation, and since also the pulse was not palpable, the blood pressure could not be obtained. The veins were engorged while the venous pressure was found to be 29 cm. of water. There was moderate oedema of the ankles and face, the liver was markedly enlarged (to the level of the umbilicus) and tender, and the spleen was just palpable.

There was considerable enlargement of the heart both to the right and left. The apex beat was felt behind the 6th rib, 5 inches from the mid-line. The rate of the heart was found to be 124 per minute. The first heart sound was hardly audible; a long blowing systolic murmur was heard over the left half of the præcordium. No pericardial friction sound was detected. A diagnosis of coronary thrombosis with peripheral and right-sided cardiac failure was made. After several injections of coramine, veritol, adrenalin and digoxin, the condition of the sinking patient improved. The pulse became palpable; the blood pressure rose to 90/46; the extremities regained their normal temperature. The right-sided heart failure improved on oral administration of digitalis.

On the morning of the 31st July, she again developed signs of severe peripheral failure. An electrocardiogram (figure 4) was taken at this stage. Monophasic downward deflections were noted in leads 2, 3 and 4, with characteristic 'raising' and 'upward doming' of the S-T interval in these leads. Another interesting feature was the duration of P-R which was above normal (0.22 sec.). The P-R interval had changed from an abnormally low to an abnormally high value in this case as the result of the attack. Because of the tachycardia and the length of the P-R intervals, the T waves were not easily discerned in this tracing; they appeared flattened and diphasic in the standard leads.

In spite of treatment, the patient's condition deteriorated rapidly and death occurred early in the afternoon, about three hours after the last electrocardiogram was taken.

### Discussion

The association of a short P-R interval with a conduction defect and the tendency to attacks of paroxysmal tachycardia in this case raises the question whether it is not an example of the interesting 'syndrome of short P-R interval, apparent bundle branch block and associated paroxysmal tachycardia' described for the first time in 1930 by Wolff, Parkinson and White (1930). This interesting and rare syndrome, of which about 110 cases are now on record, is sometimes known as the 'Short P-R: B.B.B. Syndrome' or as The Wolff, Parkinson and White Syndrome. Not a single case of this type has been recorded in India or other eastern countries.

The main features of this syndrome have been analysed recently by Hunter, Papp and Parkinson (1940). The syndrome has been observed in individuals ranging in age from 4 to 62. In about 20 per cent of the recorded cases there has been associated heart disease, *viz.*, hypertension, mitral stenosis, aortic regurgitation and coronary thrombosis. About four-fifths of



the cases on record were free from detectable organic heart disease. The characteristic electrocardiographic features of this syndrome are: with a normal heart rate, the P-R interval is considerably reduced (often under 0.12 sec.), the iso-electric segment between P and R being abolished; there is a widening of the QRS complex (usually over 0.11 sec.) with marked notching and slurring of its deflections; the condition is apt to be regarded as one of bundle branch block. Between true bundle branch block and the aberrant ventricular complexes of the Short P-R : B.B.B. Syndrome the resemblance is close, but the two conditions are regarded as distinct by the majority of workers. The paroxysms of tachycardia, to which these patients are prone, are usually supraventricular in type, but they may be ventricular or even paroxysms of fibrillation. The condition is essentially benign except for an occasional death usually from congestive cardiac failure; because of the benign character of the condition we are completely ignorant of the pathological lesions responsible.

No satisfactory explanation has been given of the mechanism of the syndrome. It has variously been ascribed to (1) a true bundle branch block from some abnormal vagal effect (Wolff, Parkinson and White, 1930), (2) the presence of a paranodal pacemaker due to an irritative lesion near the A. V. Node (Pezzi, 1931), (3) fatigue of the conducting tracts (Sigler, 1933), (4) a simultaneous block of one bundle branch and of the sino-auricular pathway (Hauss and Schutt, 1938), (5) a double rhythm caused by two interfering pacemakers, one near the sinus and the other in one bundle branch (Hunter, Prapp and Parkinson, 1940). The extensive literature on the subject has been recently reviewed in a masterly fashion by Hunter, Prapp and Parkinson (1940).

A diagnosis of the present case appears to depend on a correct interpretation of the aberrant electrocardiographic complexes observed in figures 2 and 3. The nature and duration of the QRS complexes in these tracings suggest a diagnosis of so-called *intraventricular* or *arborization* block. The latter entity is said to display the following characteristic electrocardiographic abnormalities: prolongation of the individual ventricular QRS complexes to beyond 0.10 sec.; notching or splintering of the R or S or both; low voltage curves; T waves not grossly abnormal; the initial ventricular complexes not necessarily opposite in sign in leads 1 and 3. Though intraventricular block has been attributed in the past to lesions involving the sub-endocardial Purkinje fibres and their terminal endings in the ventricular musculature, the tendency at the present day is to regard the condition as a disorder of one or both main bundle branches rather than as a disorder of the terminal ramifications. In Mahaim's (1932) opinion, intraventricular block results from a 'complete destruction of both main branches of the Bundle

of His without auriculo-ventricular block'. Electrocardiographic tracings somewhat similar to those of the present case, with widened QRS complexes and broad and slurred S deflections, have been recently independently described and classified by von Deesten and Dolganos (1934) and by Bayley (1934) as representative of right bundle branch block. Wilson, Johnston and Barker (1934) have recently reported electrocardiograms 'of an unusual type' in cases of right bundle branch block. Their tracings are very similar to those of the present case. They lay stress on the following electrocardiographic features: Increased duration of QRS complexes in all leads; in lead 1, the ventricular deflections are small, there is a conspicuous S deflection and the T is usually flat or upright; in leads 2 and 3, there is a small R followed by a deep and broad S wave; the T waves in leads 2 and 3 are upright. These authors have been able to show, with the use of præcordial leads, that the above-mentioned electrocardiographic picture constitutes an unusual form of right bundle branch block, where the ventricular complexes owe their aberrant character to some superadded peculiarity, e.g., an alteration in the position of the heart, infarction of the free or septal wall of the left ventricle or disease of some of the branches of the left bundle branch. After a perusal of these recent papers, one feels justified in interpreting electrocardiograms 2 and 3 of the present case as depicting *right bundle branch block*.

The case described here satisfies the three criteria necessary for a diagnosis of the Wolff, Parkinson and White Syndrome. There is the characteristically short P-R interval (0.10 sec.); there is an apparent bundle branch block and there is definite evidence of paroxysmal tachycardia. In view of these features, I have no hesitation in regarding the case as one of the short P-R : B.B.B. Syndrome, described by Wolff, Parkinson and White (1930). The following features in the present case are sufficiently unusual to deserve comment:—

(1) The presence of mitral stenosis. Though in about 80 per cent of the recorded cases of this syndrome there has been no associated heart disease, definite heart lesions have been described in about 20 per cent. Mitral stenosis has been described in association with the short P-R B.B.B. Syndrome on several occasions.

(2) Death from coronary thrombosis. The benign character of the short P-R : B.B.B. Syndrome has been commented on by all writers on the subject; a fatal termination is very unusual in these cases. Wilson reported death in a case of this type during an attack of paroxysmal tachycardia. A patient observed by Hunter, Papp and Parkinson (1940) died of congestive cardiac failure. Though the condition has been described in association with disease of the coronary arteries (Fulchiero, 1935; Katz and Kaplan, 1938), death from coronary



thrombosis, it is believed, has not previously been reported.

(3) The case presents interesting electrocardiographic features. There are frequent ventricular extra-systoles (figure 3); the S waves are widened and display slurring and notching in all leads. It is interesting to note that in the great majority of reported cases of this syndrome, notching and slurring has been more conspicuous in the R than in the S wave of the ventricular complex.

(4) The exact nature of the paroxysm of tachycardia in this case is not easy to determine. Though the general appearance of the curves in figure 1 suggests tachycardia of ventricular origin, a similar, if not identical, appearance may be simulated by supra-ventricular tachycardia occurring in association with a conduction defect. 'During a supra-ventricular paroxysm there may be bundle branch block; this is sometimes observed in young people who have a short P-R interval. The resultant anomalous ventricular complexes may simulate those of a ventricular paroxysm' (Cowan and Ritchie, 1935).

#### Summary

(1) A case is described for the first time in India of the rare 'syndrome of short P-R interval, apparent bundle branch block and associated paroxysmal tachycardia', also known as the short P-R : B.B.B. Syndrome or the Wolff, Parkinson and White Syndrome.

(2) The electrocardiographic tracings of the case are discussed in the light of recent studies on the subject by American workers.

(3) A short summary is presented of our present-day views on the subjects of intraventricular block and the short P-R : B.B.B. Syndrome.

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## PARATYPHOID INFECTIONS IN INDIA

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IN a recent communication, Sulakhe (1941) has doubted the validity of Lakin's (1937) statement regarding the prevalence of paratyphoid A infections in India. Out of 75 consecutive cases studied by him, all except one are reported to have been due to infection by *Bacterium typhosum*. Minchin (1939) has also taken the same view. Out of 444 cases which were treated in the General Hospital, Madras, during 1936-38, there were only three cases of *B. paratyphosum A* and two of *B. Soman* (1932) found that 2 out of his 26 positive cases were *paratyphosum A* and in a subsequent paper (1934) he reported that out 112 bacteriologically positive cases, 19 were infections with *paratyphosum A*.

Such divergent conclusions might result from—

(1) Regional or seasonal variations in the incidence of paratyphoid infection in India.

(2) Differences in the standards used for bacteriological diagnosis and (or)

(3) Variations in the type of data selected for study.

A few cases, which have come under our observation in which the diagnosis of *paratyphosum A* has been definitely established by the isolation of the causative organism, may be briefly described below, because they might be helpful in the consideration of the points raised above :—

Case 1.—A male, aged 12 years. Domestic servant in the house of case 2. Fever of 7 days' duration. Blood and stools cultured and Widal done on the 7th day. Result : *paratyphosum A* obtained from blood culture. Widal positive 1 in 25 *B. typhosum* and 1 in 50 *B. paratyphosum A*. Stool culture negative. Temperature reached normal on the 16th day. Widal on the 16th day, positive 1 in 25 *B. paratyphosum A*.

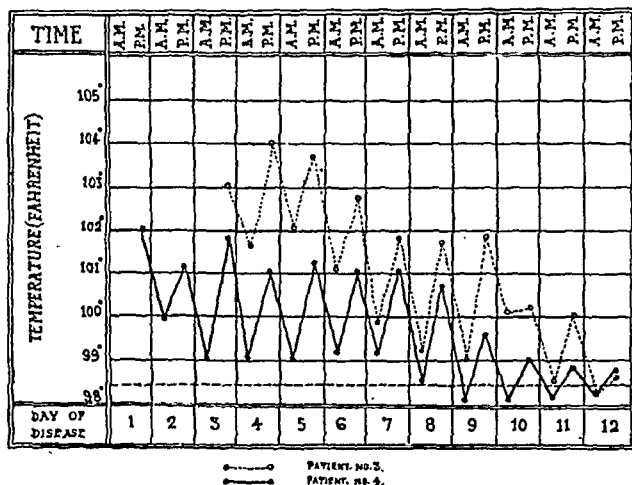
Case 2.—A female, aged 35 years. Fever started 7 days after case 1, but was so mild that patient went about in her usual manner. Blood taken for culture and Widal on the 7th day. *B. paratyphosum A* obtained from culture. Widal positive 1 in 50 *B. typhosum* and 1 in 25 *paratyphosum A*. Temperature normal on the 15th day; was never above 99°F. in the morning. Widal on the 21st day positive 1 in 50 *B. paratyphosum A*, and 1 in 25 *paratyphosum B*. Stools cultured twice in the second week—negative.

Case 3.—A male, aged 15 years, son of case 2. Fever started 5 days after no. 2. Blood taken for culture and Widal on the 2nd day. *B. paratyphosum A* isolated from blood culture. Widal positive 1 in 25 *B. typhosum*. Temperature reached normal on the 12th day (vide chart 1). Widal done again on the 21st day—positive 1 in 200 *B. typhosum* and 1 in 50 *paratyphosum A* and *B*. Stool culture done in the second week—negative. After the temperature had remained normal for 10 days, there was a relapse which ran a course like the first attack.

Case 4.—A female, aged 9 years, sister of case 3. Fever started 14 days after her mother (case 2). Blood culture not done. Widal done on the 9th day—positive 1 in 200 *B. typhosum* and 1 in 50 *paratyphosum A*. Temperature reached normal on the 9th day.

Stool culture—negative (*vide* chart 1). Being a small thin irritable girl, only a few drops of blood could be obtained from her, and so no blood culture was done, but there can be little doubt that *B. paratyphosum* A was the causative organism in view of the other three cases and the Widal result identical with that of case 3. The temperature chart of case 1 was like that of case 3 and case 2 resembled case 4.

CHART 1



This is the second occasion within the last five years when, owing to proximity of the house to this laboratory, a family outbreak of paratyphoid fever could be studied bacteriologically. The salient features of the first outbreak reported by the senior writer in the Travancore Medical Journal (1936) are worth noting here.

**Case 5.**—A male, aged 32. Fever of insidious onset, with blood stained slime and diarrhoea of 4 days' duration. Blood culture and Widal done on the 4th day. *B. paratyphosum* A isolated from blood. Widal negative. Stools culture—negative. Temperature reached normal on the 12th day. Patient was discharged 4 days later. Widal done a second time, on the 12th day—positive 1 in 25 dilution *B. paratyphosum* A, the titre of agglutination being the same for the formalized stock suspension and the living suspension of the patient's own organism.

**Case 6.**—A female, aged 12 years, an inmate of the same house. Fever began 5 days after case 5; but was so mild that patient did not take to bed till the 5th day, when culture of blood and Widal were done. *B. paratyphosum* A isolated from blood. Widal negative. The temperature did not touch normal for a month. Widal was done at the end of the second week and third week. Result (second week): positive 1 in 100 dilution *B. typhosum* and 1 in 25 *B. paratyphosum* A; (third week): positive 1 in 200 *B. typhosum* and 1 in 50 *paratyphosum* A and *B. Agglutinated* with patient's own organism to the same titre as the stock suspension of *paratyphosum* A. Stool culture done four times from the 10th to the 24th day. *B. paratyphosum* A isolated on the first two occasions and negative subsequently.

**Case 7.**—A female, aged 18 years. Inmate of the same house. Fever started 4 days after case 6. Blood taken for culture and Widal on the 3rd day. Result: *B. paratyphosum* A obtained from blood. Widal negative. Widal was repeated 9 days later, with the same negative result. Ran a very mild course and temperature came to normal on the 12th day. Stools not cultured.

**Case 8.**—A female, aged 22 years. Fever started on the same day as case 7. Blood taken for culture and Widal on the 3rd day. Result: *B. paratyphosum* A isolated. Widal negative. Widal repeated 9 days

later. Positive 1 in 200 dilution *B. typhosum* and 1 in 50 *paratyphosum* A. Temperature came to normal on the 13th day. Stools cultured twice in the second week; *B. paratyphosum* A isolated on the first occasion. The second culture 3 days later gave an organism which resembled *B. paratyphosum* A in sugar reaction, but not in motility and specific agglutination.

**Case 9.**—A male, aged 15 years, of the same house. Fever commenced 9 days after case 8 and 7 days after he had a dose of T.A.B. vaccine. Blood taken for culture on the 3rd day. *B. paratyphosum* A isolated. Widal not done in view of the T.A.B. inoculation. Temperature remained high for over 3 weeks and did not touch normal till the fourth week.

The salient features of these cases, relevant to laboratory diagnosis, may be noted here:—

(1) Of the 9 cases occurring in two houses, blood culture was done in the first week in 8, and *B. paratyphosum* A was obtained from all.

(2) Widal, done in 7 cases at the time of blood culture, gave negative results in 5, and the results in the other 2 were difficult in interpretation (positive 1 in 25 *B. typhosum* and 1 in 50 *paratyphosum* A in one and positive 1 in 50 *B. typhosum* and 1 in 25 *paratyphosum* A in the other).

(3) Widal repeated at a later stage, in 8 cases, also gave results which were difficult to interpret. In one there was a fall in titre. In three, which were negative at first, the rise in titre was more significant for *B. typhosum* (1 in 200) than for *paratyphosum* A (1 in 50) and the same result was obtained in case 4 in which Widal was done rather late, the 9th day. One continued to be negative throughout. In one the titre rose to 1 in 25 and in another to 1 in 50.

(4) The use of living suspension of the organism obtained from the patients concerned, containing both the H and the O agglutinins (5 to 8), did not give results significantly different from those obtained with the stock formalized suspensions.

(5) Culture of stools was done in seven cases. In five, it was negative and the stools were cultured only once. In two cases (6 and 8) *B. paratyphosum* A was isolated, twice from case 6 and once from case 8. Because in both these cases, Widal, negative to start with, had shown a progressive rise in titre (1 in 200) for *B. typhosum*, a large number of non-lactose-fermenting colonies were tested from several plates to find out if there was mixed infection, but all were found to be *B. paratyphosum* A. From case 8, the second culture of stools gave organisms which resembled *B. paratyphosum* A in fermentation reaction but not in motility or agglutinability, suggesting *in vivo* variation.

(6) In seven out of the nine cases, the course of fever was very mild, the temperature coming to normal about the 10th day. In most of these, the morning temperature was generally 99°F. and the evening temperature 1° to 2° higher; (*vide* chart 1, case 4) while in others, although the temperature was higher, the duration was not longer. In two the course of fever was typical of a classical attack of typhoid fever.

thrombosis, it is believed, has not previously been reported.

(3) The case presents interesting electrocardiographic features. There are frequent ventricular extra-systoles (figure 3); the S waves are widened and display slurring and notching in all leads. It is interesting to note that in the great majority of reported cases of this syndrome, notching and slurring has been more conspicuous in the R than in the S wave of the ventricular complex.

(4) The exact nature of the paroxysm of tachycardia in this case is not easy to determine. Though the general appearance of the curves in figure 1 suggests tachycardia of ventricular origin, a similar, if not identical, appearance may be simulated by supra-ventricular tachycardia occurring in association with a conduction defect. 'During a supra-ventricular paroxysm there may be bundle branch block; this is sometimes observed in young people who have a short P-R interval. The resultant anomalous ventricular complexes may simulate those of a ventricular paroxysm' (Cowan and Ritchie, 1935).

#### Summary

(1) A case is described for the first time in India of the rare 'syndrome of short P-R interval, apparent bundle branch block and associated paroxysmal tachycardia', also known as the short P-R : B.B.B. Syndrome or the Wolff, Parkinson and White Syndrome.

(2) The electrocardiographic tracings of the case are discussed in the light of recent studies on the subject by American workers.

(3) A short summary is presented of our present-day views on the subjects of intraventricular block and the short P-R : B.B.B. Syndrome.

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## PARATYPHOID INFECTIONS IN INDIA

By RAJYASEVANIRATA C. O. KARUNAKARAN  
and

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IN a recent communication, Sulakhe (1941) has doubted the validity of Lakin's (1937) statement regarding the prevalence of paratyphoid A infections in India. Out of 75 consecutive cases studied by him, all except one are reported to have been due to infection by *Bacterium typhosum*. Minchin (1939) has also taken the same view. Out of 444 cases which were treated in the General Hospital, Madras, during 1936-38, there were only three cases of *B. paratyphosum* A and two of *B. Soman* (1932) found that 2 out of his 26 positive cases were *paratyphosum* A and in a subsequent paper (1934) he reported that out of 112 bacteriologically positive cases, 19 were infections with *paratyphosum* A.

Such divergent conclusions might result from—

(1) Regional or seasonal variations in the incidence of paratyphoid infection in India.

(2) Differences in the standards used for bacteriological diagnosis and (or)

(3) Variations in the type of data selected for study.

A few cases, which have come under our observation in which the diagnosis of *paratyphosum* A has been definitely established by the isolation of the causative organism, may be briefly described below, because they might be helpful in the consideration of the points raised above:—

Case 1.—A male, aged 12 years. Domestic servant in the house of case 2. Fever of 7 days' duration. Blood and stools cultured and Widal done on the 7th day. Result: *paratyphosum* A obtained from blood culture. Widal positive 1 in 25 *B. typhosum* and 1 in 50 *B. paratyphosum* A. Stool culture negative. Temperature reached normal on the 16th day. Widal on the 16th day, positive 1 in 25 *B. paratyphosum* A.

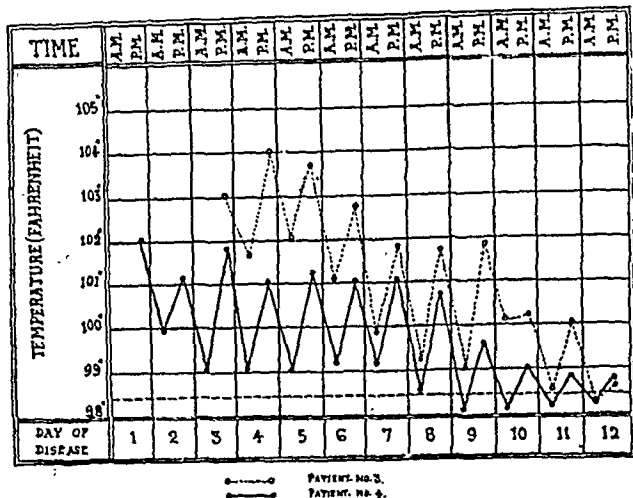
Case 2.—A female, aged 35 years. Fever started 7 days after case 1, but was so mild that patient went about in her usual manner. Blood taken for culture and Widal on the 7th day. *B. paratyphosum* A obtained from culture. Widal positive 1 in 50 *B. typhosum* and 1 in 25 *paratyphosum* A. Temperature normal on the 15th day; was never above 99°F. in the morning. Widal on the 21st day positive 1 in 50 *B. paratyphosum* A, and 1 in 25 *paratyphosum* B. Stools cultured twice in the second week—negative.

Case 3.—A male, aged 15 years, son of case 2. Fever started 5 days after no. 2. Blood taken for culture and Widal on the 2nd day. *B. paratyphosum* A isolated from blood culture. Widal positive 1 in 25 *B. typhosum*. Temperature reached normal on the 12th day (*vide* chart 1). Widal done again on the 21st day—positive 1 in 200 *B. typhosum* and 1 in 50 *paratyphosum* A and B. Stool culture done in the second week—negative. After the temperature had remained normal for 10 days, there was a relapse which ran a course like the first attack.

Case 4.—A female, aged 9 years, sister of case 3. Fever started 14 days after her mother (case 2). Blood culture not done. Widal done on the 9th day—positive 1 in 200 *B. typhosum* and 1 in 50 *paratyphosum* A. Temperature reached normal on the 9th day.

Stool culture—negative (*vide* chart 1). Being a small thin irritable girl, only a few drops of blood could be obtained from her, and so no blood culture was done, but there can be little doubt that *B. paratyphosum* A was the causative organism in view of the other three cases and the Widal result identical with that of case 3. The temperature chart of case 1 was like that of case 3 and case 2 resembled case 4.

CHART 1



This is the second occasion within the last five years when, owing to proximity of the house to this laboratory, a family outbreak of paratyphoid fever could be studied bacteriologically. The salient features of the first outbreak reported by the senior writer in the Travancore Medical Journal (1936) are worth noting here.

Case 5.—A male, aged 32. Fever of insidious onset, with blood stained slime and diarrhoea of 4 days' duration. Blood culture and Widal done on the 4th day. *B. paratyphosum* A isolated from blood. Widal negative. Stools culture—negative. Temperature reached normal on the 12th day. Patient was discharged 4 days later. Widal done a second time, on the 12th day—positive 1 in 25 dilution *B. paratyphosum* A, the titre of agglutination being the same for the formalized stock suspension and the living suspension of the patient's own organism.

Case 6.—A female, aged 12 years, an inmate of the same house. Fever began 5 days after case 5; but was so mild that patient did not take to bed till the 5th day, when culture of blood and Widal were done. *B. paratyphosum* A isolated from blood. Widal negative. The temperature did not touch normal for a month. Widal was done at the end of the second week and third week. Result (second week): positive 1 in 100 dilution *B. typhosum* and 1 in 25 *B. paratyphosum* A; (third week): positive 1 in 200 *B. typhosum* and 1 in 50 *paratyphosum* A and *B. Agglutinated* with patient's own organism to the same titre as the stock suspension of *paratyphosum* A. Stool culture done four times from the 10th to the 24th day. *B. paratyphosum* A isolated on the first two occasions and negative subsequently.

Case 7.—A female, aged 18 years. Inmate of the same house. Fever started 4 days after case 6. Blood taken for culture and Widal on the 3rd day. Result: *B. paratyphosum* A obtained from blood. Widal negative. Widal was repeated 9 days later, with the same negative result. Ran a very mild course and temperature came to normal on the 12th day. Stools not cultured.

Case 8.—A female, aged 22 years. Fever started on the same day as case 7. Blood taken for culture and Widal on the 3rd day. Result: *B. paratyphosum* A isolated. Widal negative. Widal repeated 9 days

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The salient features of these cases, relevant to laboratory diagnosis, may be noted here:—

(1) Of the 9 cases occurring in two houses, blood culture was done in the first week in 8, and *B. paratyphosum* A was obtained from all.

(2) Widal, done in 7 cases at the time of blood culture, gave negative results in 5, and the results in the other 2 were difficult in interpretation (positive 1 in 25 *B. typhosum* and 1 in 50 *paratyphosum* A in one and positive 1 in 50 *B. typhosum* and 1 in 25 *paratyphosum* A in the other).

(3) Widal repeated at a later stage, in 8 cases, also gave results which were difficult to interpret. In one there was a fall in titre. In three, which were negative at first, the rise in titre was more significant for *B. typhosum* (1 in 200) than for *paratyphosum* A (1 in 50) and the same result was obtained in case 4 in which Widal was done rather late, the 9th day. One continued to be negative throughout. In one the titre rose to 1 in 25 and in another to 1 in 50.

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(6) In seven out of the nine cases, the course of fever was very mild, the temperature coming to normal about the 10th day. In most of these, the morning temperature was generally 99°F. and the evening temperature 1° to 2° higher; (*vide* chart 1, case 4) while in others, although the temperature was higher, the duration was not longer. In two the course of fever was typical of a classical attack of typhoid fever.

Three more cases may also be briefly noted here, as they are helpful in considering the occurrence of paratyphoid infections.

**Case 10.**—A female, aged 40 years. A highly qualified doctor working in Madras. Fever started 2 days after her arrival from Madras. She had a full course of T.A.B. a month before and had not exposed herself to risks of infection. Fever was of an intermittent character, coming in the forenoon with a feeling of chilliness. Malaria was excluded and because she had *B. coli* infection before, a recurrence of this was suspected and she tried a course of M.&B. 693. After the fever had lasted a week one of us (C. O. K.) was consulted. Blood, urine and stools were cultured and Widal was done. Urine and blood were sterile. Widal was positive in 1 in 200 *B. typhosum* and 1 in 50 *paratyphosum A* and 1 in 25 *paratyphosum B*. Culture of stools gave almost a pure growth of *B. paratyphosum A*.

**Case 11.**—A male, aged 28 years. A labourer employed in the high lands of Travancore, 200 miles from this laboratory. Fever started 7 days after patient had an inoculation with 0.75 c.cm. of T.A.B. Sudden rise of temperature. Pulse rate 60 to 70 with a temperature ranging from 100°F. to 102°F. Severe abdominal distress and diarrhoea alternating with constipation. Rapid emaciation from the commencement of fever. Temperature reached normal on the 12th day (*vide* chart II). Widal done 7 days after

the *Salmonella* group other than *paratyphosum A* and *B* isolated.

**Case 12.**—A male, aged 10 years. From the same district as the last case, but from another estate and not a contact. Blood sent for Widal on the 9th day. Result: positive 1 in 200 *B. typhosum* and 1 in 50 *paratyphosum B*. *B. typhosum* isolated from culture of clot. Because there was agglutination of *B. typhosum B*, a specimen of stools was obtained 11 days later and *B. paratyphosum B* was isolated.

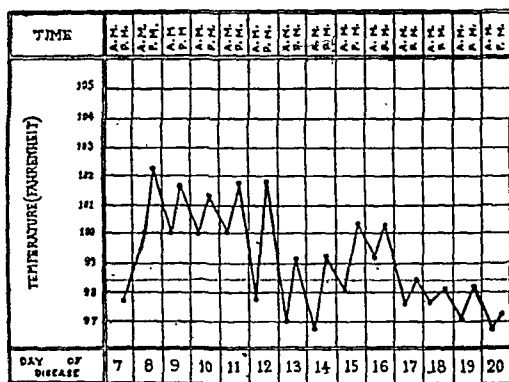
### Discussion

As Topley and Wilson (1936) have emphasized, 'the actual isolation and identification of the causative organism is always the method of choice in the bacteriological diagnosis of enteric infection'. Although it is possible to isolate the organism from the blood, stools and urine, culture of the blood and/or stools is the routine procedure adopted in most diagnostic laboratories. From the cases described above, it will be seen that early blood culture gave positive results in 8 out of the 9 cases, and that stool culture was helpful in 5 out of 11 cases. But as has been stated already, the first 9 of these cases occurred in two houses close to this laboratory and so presented unusually favourable opportunities for study. These results may not therefore be strictly applicable to the routine samples received in any laboratory.

The results of culture examination of stools and blood done for the diagnosis of enteric fever in this laboratory during the administrative years 1939-40 (the administrative year begins about the 15th August) and 1940-41 together with the corresponding figures for the King Institute of Preventive Medicine, Madras, published in the Annual Reports for 1939 and 1940 are given in table I.

It might be thought that if blood culture and/or Widal be positive, culture of stools is not necessary for diagnosis and so the specimens of stools come more from cases which are not enteric in character, vitiating the comparability of the results. It has therefore to be pointed out

CHART 2



PATIENT NO. 11.

the onset of fever, positive in 1 in 800 *B. typhosum*, *paratyphosum A* and *B*. Culture of clot sterile. Culture of stools done in the third week, an organism of

TABLE I

| Institution                           | CULTURE OF BLOOD     |                    |                          |  | CULTURE OF STOOLS |                                 |                                       |  |
|---------------------------------------|----------------------|--------------------|--------------------------|--|-------------------|---------------------------------|---------------------------------------|--|
|                                       | Total                | <i>B. typhosum</i> | <i>B. paratyphosum A</i> | Other organisms of the <i>Salmonella</i> group | Total             | Positive for <i>B. typhosum</i> | Positive for <i>B. paratyphosum A</i> | Other organisms of the <i>Salmonella</i> group |
| Public Health Laboratory, Trivandrum— |                      |                    |                          |  |                   |                                 |                                       |  |
| 1939-41 ..                            | 1,230<br>(217 clots) | 283                | 12                       | 3  | 1,177             | 58                              | 3                                     | 23   |
| 1940-41 ..                            | 1,426<br>(360 clots) | 239                | 12                       | 6  | 1,330             | 56                              | 13                                    | 28   |
| King Institute—                       |                      |                    |                          |  |                   |                                 |                                       |  |
| 1939 ..                               | 658                  | 106                | 3                        | 1  | 1,194             | ..                              | ..                                    | ..   |
| 1940 ..                               | 1,294                | 251                | ..                       | 2  | 99                | ..                              | 6*                                    | ..   |

\* Not differentiated.

N.B.—Clots of satisfactory specimens sent for Widal are also cultured as noted in brackets.

that about 90 per cent of the specimens examined here culturally for the diagnosis of enteric come from the General Hospital, Trivandrum, which is adjacent to this institution and the practice there is, whenever possible, to collect a specimen of stools from every case of suspected enteric fever on the day or the day after the blood is taken for culture and Widal. If cultural and serological tests are negative and clinically the case appears to be enteric, the stool culture is repeated at least once in the second or third week. In about 80 per cent of the admissions as will be shown later, both the blood and stools have been cultured. That makes the results fairly comparable and it will be seen that if we are to base our judgment of the incidence of the different types of enteric infection on the isolation of the causative organism, we have to depend more on blood culture than on stool culture.

✓ Blood culture to be reliable should be done as early in the course of fever as possible, but usually patients seek hospital admission after the first week when the fever is well established. Soman (1932) had noted that the earliest date of admission was the 7th day, and 23 out of 26 patients came after the 10th day. Only 8 out of his 70 cases were culturally positive. The same author (1934) observed that only 4 out of 38 came within the first week and 53 out of his 400 cultures were positive. Sulakhe (1941) attempted culture in only 4 out of 75 consecutive cases 'because most of the cases came late' and even these 4 cases were negative.

In the series reported by Minchin (1939), '50 per cent of the cases showed a positive blood culture'. It has however to be noted that Minchin's was a highly selected group consisting only of cases which were either culturally positive or positive by Widal to the titre of 1 in 200. His cases, 444 in number, were selected from the years 1936-38, while 1,363 cases were treated as 'enteric fever' in the same hospital (the Madras General Hospital) in 1936. If his culturally positive cases (222) be distributed between the two years of their occurrence, it works out at about 111 positives in about 1,300 cases, clinically diagnosed as enteric, and this proportion is approximately the same as for the groups reported by Soman. It is also worth noting that 71 per cent of the positives in Minchin's group came within 10 days after the onset of fever. That means that only 32 out of about 111 positives were obtained from the later admissions which would have constituted the vast majority of the cases treated. While it was necessary for Minchin's purpose to select cases in which specific diagnosis of typhoid was established, it appears doubtful if an opinion regarding the incidence of paratyphoid fever can be based on such a selected group, particularly in view of the limitations to which both culture and Widal, as practised in routine diagnosis, are subject.

The results of bacteriological tests done in this laboratory in 755 cases of enteric fever admitted to the General Hospital, Trivandrum, during 1940-41, given in table II will be of

TABLE II

| Duration of disease | Total number | POSITIVE BY CULTURE ONLY |                          |  | POSITIVE BY CULTURE AND WIDAL |                          |  | POSITIVE BY WIDAL ONLY |   |                          |   | Negative |
|---------------------|--------------|--------------------------|--------------------------|--|-------------------------------|--------------------------|--|------------------------|---|--------------------------|---|----------|
|                     |              | <i>B. typhosum</i>       | <i>B. paratyphosum A</i> | Other organisms of the <i>Salmonella</i> group | <i>B. typhosum</i>            | <i>B. paratyphosum A</i> | Other organisms of the <i>Salmonella</i> group | <i>B. typhosum</i>     | <i>B. typhosum</i> with <i>paratyphosum A</i> | <i>B. paratyphosum A</i> | <i>B. paratyphosum B</i> alone, or in combination |          |
| 1st week            | 135          | 13                       | 4                        | 7  | 26                            | 9                        | 2  | 34                     | 8   | 9                        | 2   | 22       |
| 2nd week            | 437          | 44                       | 6                        | 5  | 75                            | 4                        | ..   | 187                    | 25  | 21                       | 4   | 69       |
| 3rd week            | 133          | 4                        | ..                       | 2  | 29                            | 1                        | ..   | 66                     | 8   | 3                        | 1   | 19       |
| 4th week            | 50           | 3                        | ..                       | ..   | 7                             | 1                        | ..   | 30                     | 1   | 1                        | ..  | 7        |
| TOTAL ..            | 755          | 64                       | 10                       | 14   | 137                           | 15                       | 2  | 317                    | 42  | 34                       | 7   | 117      |

Footnote.—The sum total of the results will be found to exceed the sum total of the number of cases by 4 because there were 4 cases from which more than one organism was isolated. One case had both *B. paratyphosum A* and *B* in the blood culture. This had a positive Widal of 1 in 50 for *B. typhosum* and 1 in 25 for *B. paratyphosum A* and *B*. There were two cases with a Widal of 1 in 200 *B. typhosum* and 1 in 50 *paratyphosum A* from the stools culture of which *B. paratyphosum A* was isolated. Another with the same reaction had *B. typhosum* in the blood and *paratyphosum A* in the stools. One case with a negative Widal in the second week had *B. paratyphosum A* in the blood and *B. typhosum* in the stools and another with a negative Widal had *B. typhosum* in the blood and *paratyphosum A* in the stools. It may also be noted that there were 3 cases in which *B. typhosum* was isolated from the blood, two months after the commencement of the fever, 2 of which were Widal negative, and 4 in which blood culture was positive one month after the fever, one of which was Widal negative.



interest. Altogether 789 cases were clinically diagnosed as enteric fever, of which 34, admitted in a moribund condition, died before any test could be done. Out of the remaining 755 cases, Widal and culture of both blood and stools were done in 553 cases, blood culture and Widal in 168, stool culture and Widal in 54.

Table III shows how the chances of isolation of the organism get progressively less with the delay in culture, and how this affects the isolation of *B. paratyphosum A* more than *B. typhosum*.

TABLE III

| Time     | Total | POSITIVES |          | POSITIVE FOR<br><i>B. typho-<br/>sum</i> |          | POSITIVE FOR<br><i>paratypho-<br/>sum A</i> |          |
|----------|-------|-----------|----------|--|----------|---|----------|
|          |       | Total     | Per cent | Total                                    | Per cent | Total                                       | Per cent |
| 1st week | 135   | 60        | 44       | 39                                       | 29.6     | 13  | 9.6      |
| 2nd week | 437   | 131       | 30       | 116                                      | 24.2     | 10  | 2.3      |
| 3rd week | 133   | 36        | 27       | 33                                       | 24.8     | 1   | ..       |
| 4th week | 50    | 11        | 22       | 10                                       | 20.0     | 1   | ..       |

It will be seen from table III that among the cases admitted in the first week, there is one case of culturally positive *B. paratyphosum A* for every 3 of *B. typhosum*, while for the second week cases, the proportion goes down to 1 : 11.6. The number of cases from which *B. paratyphosum A* was isolated in the third and fourth week groups is so small (1 in each group) as to be of little significance. The onset of enteric fever being generally insidious, the duration of the disease, at the time of admission, is liable to be understated, and so the first week admissions might be fewer than the hospital statistics suggest. Even if no allowance is made for this, only about 17 per cent of the total—135 in 789—were admitted in the first week. The tendency to seek admission late affects the isolation of *B. paratyphosum A* in two ways :—

(i) The paratyphoid infections being, in general, mild both in the duration and intensity of the fever, the vast majority find no necessity to seek hospital admission. Hospital records are therefore likely to show a disproportionately larger number of cases of infection with *B. typhosum*.

(ii) Bacteræmia being more transient in paratyphoid infections, there is less chance of isolation of the causative organisms by blood culture after the first week.

Isolation of the causative organisms from the stools does not appear to be generally attempted in the routine diagnosis of enteric fever. Soman, Minchin and Sulakhe, in their papers referred to above, do not mention stool culture. This, as stated already, might be due to the chance of isolation of the organism from the stools, particularly in the early stages of the disease,

being more remote than isolation from the blood. But whatever the limitations of stool culture as practised in routine diagnosis, from a purely clinical point of view there can be little doubt that, in the isolation of the causative organisms, especially of the organisms belonging to the *Salmonella* group, stool culture is of importance.

A reference to table II will show that in 1940-41, there were in the General Hospital, Trivandrum, 201 cases from which *B. typhosum* was isolated and 25 from which *B. paratyphosum A* was isolated. But 48 of the blood positives were obtained from 168 cases in which blood culture alone was done and 5 of the stool positive were obtained from 54 cases in which stools alone were cultured. The remaining 173 positive cultures were distributed among 170 cases as in table IV, 3 being mixed infections in which both *B. typhosum* and *B. paratyphosum A* were isolated.

TABLE IV

|                                    | <i>B. typho-<br/>sum</i> | <i>B. para-<br/>typhosum A</i> |
|------------------------------------|--------------------------|--------------------------------|
| Positive by blood culture ..       | 114                      | 11                             |
| Positive by stool culture ..       | 22                       | 13                             |
| Positive by both blood and stools. | 12                       | 1                              |
| TOTAL ..                           | 148                      | 25                             |

It will be seen from table IV that in *B. typhosum* infections, blood culture was helpful in 86.5 per cent (126 out of 148) of the positive cases and stool culture in 24 per cent (34 out of 148), but in infections with *B. paratyphosum A*, blood culture was helpful only in 48 per cent (12 out of 25) and stool culture in 56 per cent (13 out of 25). The more transient character of bacteræmia in paratyphoid cases and the mild and atypical early manifestations which often lead to the missing of the period of bacteræmia, give to stool culture a significance which it does not have in infections with *B. typhosum*.

Although isolation of the causative organism is the method of choice for the diagnosis of enteric fever and for determining the distribution of the different types of infections, an opinion on both these points appears to be more commonly based on the results of Widal. But the interpretation of agglutination tests presents many difficulties and different workers follow different standards. Soman (1932) considered Widal reaction positive if agglutination occurred in a dilution of 1 in 50. He had in his 26 bacteriologically confirmed cases 2 positives for *B. paratyphosum A*. The same author (1934) considered Widal positive for *B. paratyphosum A* if reaction occurred in a serum dilution of 1 in 25, and 19 out of his 112 bacteriologically positives were infections with *B. paratyphosum A*. Minchin's standard was a titre of 1 in 200 dilution. Only 3 out of

his 444 cases were considered to be *paratyphoid* A. Sulakhe took 1 in 100 as the diagnostic dilution and although he had among his 45 Widal positives three which were also positive for *B. paratyphosum* A and B in addition to *B. typhosum*, he has taken these cases as simple infections with *B. typhosum*. The number of Widal positives will obviously depend upon the titre accepted as of diagnostic significance.

As Topley and Wilson (1936) say 'no arbitrary titre can be selected at or above which an agglutination can be regarded as positive in the diagnostic sense, and below which it can be regarded as negative'. These authors have stressed the importance of the 'natural level of agglutinins among a random sample of the population' in the interpretation of agglutination reaction. No work appears to have been done in India to find out the natural level of agglutination, and the different standards selected by the different authors are arbitrary. Differences in technique and variations in the agglutinability of non-standardized bacterial suspensions used for the test also make comparison of results difficult. The fluctuation in the titre of agglutinins, and the development of the non-specific agglutinins further complicate the correct interpretation of results. The cases cited by Soman (1934) and by Minchin (1939) show that the titre of agglutinins is subject to wide range of variation. This variation is more

1, towards the end of the second week the titre might begin to fall. The clinical course of the infection makes it likely that usually the patients would be discharged by the end of the second week and so a late Widal would hardly be done. If the results of the Widal test, collected from hospitals or diagnostic laboratories, are to be depended upon to find out the extent of paratyphoid incidence, a titre of about 1 in 25 will be more likely to minimize errors than a higher titre.

Table II will show that among the cases in which a diagnosis of enteric fever was based solely on the results of Widal, 317 were positive for *B. typhosum*, only 34 for *B. paratyphosum* A and 42 for both, a titre of 1 in 25 or above being taken as significant for *B. paratyphosum* A, and a titre of 1 in 50 or above as significant for *B. typhosum*.

Table V shows the results of Widal done in this laboratory during the years 1939-40 and 1940-41 and table VI the corresponding figures for the King Institute (1939 and 1940).

At the King Institute (1942)\* 'positive results from 1 in 25 upwards are reported as positive' in their reports, while in table V we have taken a titre of 1 in 50 alone as significant in the case of *B. typhosum*. This undoubtedly accounts for a much larger number of positives for *B. typhosum* obtained at the King Institute.

TABLE V

| Year    | Total done | 1 : 50<br><i>B. typhosum</i> | 1 : 25<br><i>B. paratyphosum</i> A | <i>B. typhosum</i><br>and <i>para-</i><br><i>typhosum</i> A | 1 in 25<br><i>B. paratyphosum</i> B | <i>Paratyphosum</i> B<br>and<br><i>B. typhosum</i> | <i>Paratyphosum</i> A<br>and<br><i>typhosum</i> B | <i>B. typhosum</i> ,<br><i>paratypho-</i><br><i>sum</i> A and<br><i>paratypho-</i><br><i>sum</i> B |
|---------|------------|------------------------------|------------------------------------|---|-------------------------------------|--|---|--|
| 1939-40 | 2,614      | 454                          | 43                                 | 122   | 27                                  | 32   | 9   | 54   |
| 1940-41 | 3,178      | 397                          | 96                                 | 182   | 10                                  | 15   | 8   | 51   |

TABLE VI

| Year    | Total | Positive<br><i>B. typhosum</i> | <i>B. paratyphosum</i> A | <i>B. paratyphosum</i> B | Positive to more<br>than one organism |
|---------|-------|--------------------------------|--------------------------|--------------------------|---------------------------------------|
| 1939 .. | 3,900 | 1,590                          | 12                       | 25                       | 219                                   |
| 1940 .. | 4,275 | 1,812                          | 32                       | 20                       | 381                                   |

likely to affect the correct diagnosis of paratyphoid infections than of typhoid cases, probably because, the bacteraemia being more transient, the highest titre obtained is comparatively low. Topley and Wilson say that during the third week of the disease 'with paratyphoid infections the titre against the causative organisms will tend to be at least as high as that observed in typhoid fever' (1 in 100 or over). The cases enumerated above will show that the rise in titre is seldom higher than 1 in 50 and that in some it is only 1 in 25 and that, as in case

With reference to the paratyphoid organisms, the standard being the same, the results, particularly the positives for more than one organism, are comparable. If in these cases, the chances of infection with *B. typhosum* producing non-specific agglutinins for *paratyphosum* and vice versa be considered even, as many cases will be due to the one as to the other and the number of paratyphoid cases will be found to be fairly high.

\* Personal communication from the Director.

The development of agglutinins to organisms other than the causative organism, which cannot be explained on the basis of antigenic relationship, is a common phenomenon, but it does not appear to have been sufficiently recognized that the titre for an allied organism may be much higher than the titre for the causative organism. In 4 of the 9 cases mentioned above which were undoubtedly infections with *B. paratyphosum* A alone, the titre for *B. typhosum* rose to 1 in 200 while the titre for the causative organism did not rise above 1 in 50. These were all uninoculated subjects without any history of previous attacks of enteric fever and it may be noted that there was significant rise in titre of agglutinins in the three cases in which two tests were done. Where the diagnosis is based on the results of Widal and particularly if low titres are not considered of diagnostic value, as has been done by Minchin and Sulakhe, it is likely that such cases will be grouped under infection with *B. typhosum*.

#### Summary and conclusions

(1) Bacteriological findings and clinical course in some cases of paratyphoid fever are described.  
(2) The bacteriological findings of the cases diagnosed as 'enteric fever' treated in the General Hospital, Trivandrum, during 1940-41 are analysed.

(3) The results of culture and agglutination done at the King Institute and the Trivandrum Public Health Laboratory are analysed.

(4) Early blood culture is of the greatest value in establishing a correct diagnosis in paratyphoid infections.

(5) The interpretation of Widal is complicated by the low titre of agglutinins in many cases and by the development of non-specific agglutinins in others.

(6) Stool culture is helpful in late cases and cases showing agglutinins to more than one organism.

(7) In general, paratyphoid infection runs a mild course and are not likely to be well represented among the cases admitted in hospitals or specimens tested in diagnostic laboratories.

(8) An opinion on the incidence of paratyphoid infections based on the analysis of hospital statistics is therefore likely to be misleading.

(9) It appears probable that many fevers of short duration in which no bacteriological investigations are done might be paratyphoid in character.

(10) A study of the cases admitted in the General Hospital, Trivandrum, and the results of Widal test done at the King Institute and in this laboratory indicate a fairly wide prevalence of *paratyphosum* A infection.

#### Acknowledgments

Our thanks are due to Dr. S. John, superintendent of the General Hospital,

(Concluded at foot of next column)

## THE RÔLE OF *BACILLUS FÆCALIS* *ALCALIGENES* AS A PATHOGEN IN CYSTITIS OF URINARY BLADDER

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### CASE REPORT

AN unmarried female, age about 21, came under the observation of Dr. H. N. Dass, about the middle of February 1940, for the treatment of irregular fever of two weeks' duration, severe pain and tenderness in the suprapubic region, and frequent and painful micturition of about the same duration as the fever. The fever came on with rigor towards the evening, the temperature ranging between 100° and 102°F.

On examination, the tonsils were found enlarged; there was constipation; marked tenderness in the suprapubic region was elicited but the kidneys were free from abnormal signs and symptoms. No abnormality was detected in other systems. Blood films were free from malaria parasites and *microfilaria*. The patient was treated for three days with sedatives, expectorants and sodium salicylate. The tonsillar condition subsided but the temperature remained unaffected and the patient was then given potassium citrate, dr. 1, four hourly for four days, and then acid sodium phosphate and urotropine for three days. The temperature fell to normal and no relapse has been recorded since.

### Investigation of the case

Catheterized urine collected under sterile conditions just before the treatment was started was sent to the writer to confirm the diagnosis of '*B. coli*' infection, already made clinically. The urine was slightly turbid, alkaline in reaction, and albumin was present. The deposit showed pus cells, epithelial cells and red blood corpuscles. No casts were found. 'Hanging drop' preparations showed motile bacilli. Deposit-smears stained with Gram's and Leishman's stains showed Gram-negative short bacilli and the cellular elements mentioned above. A culture was made on a MacConkey's plate incubated at 37°C. for 24 hours. The organisms were found to be non-lactose fermenters.

(Continued from previous column)

Trivandrum, for placing at our disposal his case records, to Dr. Finlayson, chief medical officer, Kannan Devan Plantations, and Dr. Raghava Puduvai for their permission to publish records of their cases, and to the Director of research, University of Travancore, for his permission to publish this paper.

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**Morphology.**—A short, rod-shaped, non-spore-bearing, motile bacillus.

Cultures were made on: nutrient agar, nutrient broth, peptone water, buffered glucose broth, MacConkey's agar plate, Dieudonne's blood-alkali agar, potato medium and litmus milk.

Sugar reactions in lactose, glucose, saccharose, mannite and maltose: no acid and gas, but alkali formation only.

Litmus milk: progressive alkali formation.

Indol production: absent.

Voges-Proskauer reaction: negative.

Methyl-red reaction: negative.

Gelatine liquefaction: absent.

Nitrate reduction: nitrates reduced to nitrites.

The organism was therefore proved to be *B. fæcalis alcaligenes*.

#### *Serological reaction of B. fæcalis alcaligenes isolated from the patient's urine*

A sample of blood was collected about a month after the signs and symptoms had subsided, the patient not being available earlier. The Widal test with TH, AH, BH and TO suspensions was negative in 1 in 100 and over. The test with the patient's organism (*B. fæcalis alcaligenes*) showed agglutination upto 1 in 200.

#### *Other tests*

The behaviour of the isolated organism when grown in acid urine *in vitro* was then studied as follows. A sample of urine was collected from a healthy person and distributed into two test tubes (10 c.cm. in each). The reaction, which was acid to litmus paper, was noted. The tubes containing urine were then sterilized. One was inoculated with the organism; the other was kept as a control. Observations were made after 24 hours. The results are as follows: (a) The tube inoculated with the organism showed definite turbidity and the acidity of the urine was replaced by alkalinity (tested by litmus paper). (b) The control showed no growth and the urine remained unaltered in reaction.

The effects of variation in the pH of nutrient broth on the growth of the organism isolated from patient's urine and *vice versa* were studied and the following conclusions drawn:—

1. The organism can grow under usual conditions (*i.e.*, at 37°C. in 24 hours) in nutrient broths of pH ranging from 5.4 to 8.2 with pellicle formation. Outside this range growth is poor and delayed and there is little or no pellicle formation.

2. The organism has power to produce alkali in broths, with increase in pH. The delay in the growth of the organisms in broth with pH less than 5.4 is possibly caused by the time taken for the conversion of the unsuitable pH into a suitable one, *i.e.* pH between 5.4 and 8.2. The slowness of the growth in broths with pH over 8.2 is possibly due to the high alkalinity of the media.

3. Broth with pH 8.8 definitely inhibits the growth of the organism for a long time (10 days).

4. The results of inoculation on agar slopes with pH ranging from 4.8 to 5.2 and from 8.4 to 8.8 coincide with the results of inoculation in broths of corresponding pH.

5. In nutrient agar of pH 8.4 to 8.8, the colonies are more numerous but of smaller size than those in nutrient agar of pH 7.6 (control); both the number and size gradually decreasing towards pH 8.8. In nutrient agar of pH 5.2 to 4.8, the colonies are fewer but larger than those in nutrient agar of pH 7.6; both the number and size gradually decreasing towards pH 4.8. The size of the colonies in nutrient agar of pH 4.8 is about equal to those in nutrient agar of pH 7.6.

#### *Discussion*

This case is reported on account of the comparative rarity of symptoms due to infection with *B. fæcalis alcaligenes*. 'Although *B. fæcalis alcaligenes* is frequently found in man's intestine, and may be found in large numbers in cases of enteric fever, it is rare to find any evidence of its infectivity. Some regard it as pure saprophyte.' However, many observers, Laforgue (1908), Straub and Kraus (1914), Shearman and Moorhead (1916), Rochaix and Marotte (1916), Hirst (1917) and de Magalhaes (1921) have cultivated this organism from the blood of a few cases with symptoms resembling enteric fever. Shearman and Moorhead (1917) and Ledingham (1923) isolated this organism from the blood of a group of cases of a mild paratyphoid-like fever also. Fischer (1899) found the bacillus present in pure culture in the organs of a patient who suffered from tuberculosis and broncho-pneumonia, and Hamm (1910) found it in a patient with pyelonephritis of pregnancy.

On the other hand, 'during the war, in spite of the enormous number of blood cultures made in enteric-like conditions, hardly ever was *B. fæcalis alcaligenes* encountered. Trawinski and György (1918) in thousands of examinations had negative results'.

There are a few cases on record of infection with *B. fæcalis alcaligenes* with the production of agglutinins in the blood. Such are those of Shearman and Moorhead (1917) who have recorded a few cases with agglutination at 1 in 200, and in two cases even upto 1 in 400, Rochaix and Marotte (1916) have recorded two cases with agglutination at 1 in 200 and 1 in 1,000, respectively, and Straub and Kraus (1914) have recorded one case with agglutination at 1 in 1,000. Ledingham (1923) and Hirst (1917) also have recorded cases with agglutination at 1 in 1,000. But, compared to the long period of time that has elapsed between their records and the present time, the cases recorded are very few, and none of the authors seem to have established the pathogenicity of *B. fæcalis alcaligenes* on the bladder although this organism, in a few limited

cases, was isolated by Straub and Kraus and a few others from urine.

The development of specific agglutinins to a significant titre—as high as 1 in 200—in the blood of the patient reported in this paper, with definite evidence of inflammation of the urinary bladder, and the isolation of pure *B. faecalis alcaligenes* from the urine of the patient, are strong evidence of the pathogenicity of this organism. The exclusion of infections such as typhoid and paratyphoid fevers affords further evidence of the infection, in this case being primary and due to *B. faecalis alcaligenes* alone. The establishment of the pathogenicity of *B. faecalis alcaligenes* in this case leads one to believe that some cases which have in the past on clinical grounds alone been labelled as 'B. coli infection' may possibly have been cases of *B. faecalis alcaligenes* infection.

The hypothesis advanced is that the cure of the condition depended on the inhibition of growth in the bladder by the increasing alkalinity of the urine as a result of treatment with potassium citras together with the development of immunity, as endorsed by the agglutination test.

#### Summary

1. The literature on the pathogenicity of *B. faecalis alcaligenes* is reviewed and evidence is presented for the belief that the case reported in this paper is the first recorded case of its kind, one in which infection of the urinary bladder by *B. faecalis alcaligenes* was accompanied by the production of specific agglutinins of significant titre in the blood of the patient.

2. An explanation of the cure of the condition by alkaline treatment is given.

#### Acknowledgment

I am grateful to Lt.-Col. R. H. Malone, I.M.S., for his encouragement and valuable suggestions. My thanks are also due to Dr. H. N. Dass for supplying me with the materials, and to Dr. T. V. Swamy for checking some of my results.

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## A TEN-DAY FEVER SIMULATING TYPHOID\*

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FEVERS in the medical wards, in the absence of positive bacteriological or definite clinical evidence of malaria, typhoid, tuberculosis, pyelitis, etc., are often labelled influenza, 'three-day fever', 'five-day fever' or 'pyrexia of unknown origin'. The clinical features of these fevers are not clearly recognized or correlated, and their cause remains hidden, the physician's interest in the fever falling synchronously with the falling temperature and later disappearing entirely as the patient leaves the hospital.

In this article, I am attempting to demonstrate such a continuous fever of about 10 days' duration which appears to be a well-defined clinical entity, and which though commonly diagnosed as typhoid fever differs from it completely as regards its course, complications, prognosis, sequelae and bacteriological findings.

*Clinical description.*—The present observations are based on a small series of 10 cases. The fever usually attacks young adults of either sex. The onset is always sudden, the patient developing a high temperature 102°–103.5°F. while apparently in normal health. There is no chill or rigor, and a characteristic feature of the disease is a severe frontal headache on the second day. The patient is usually seen in the hospital on the third or fourth day of illness. The face is usually flushed and anxious. The patient becomes slightly dull on the fourth or fifth day, but one never sees the toxic face or drowsiness of a typhoid patient on this date. The headache at this stage is less prominent and even absent.

*Digestive symptoms.*—The tongue was coated and dry during the first four days, not unlike that of a typhoid patient. The abdomen showed no abnormality, only one case showing a slight distension for a few hours. The spleen was palpable in 2 cases in the series, one patient had diarrhoea which subsided without much treatment. The stools were invariably solid and never 'pea-soup' in character.

*Respiratory system.*—No signs or symptoms.

*Circulatory system.*—The pulse was not recorded accurately in every case but in some cases it appeared to be on the slow side.

*Nervous system.*—No symptoms except transient headache.

*Cutaneous system.*—No rash or spots.

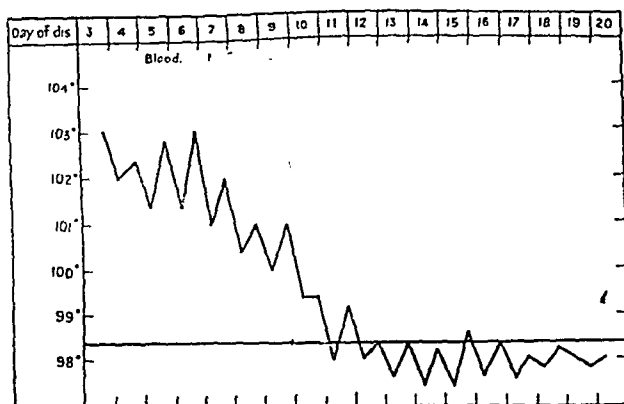
*Temperature curve.*—At first sight it looks like the second half of a typhoid chart, but the onset is sudden and there is no long plateau as in typhoid, the temperature remaining high for 3

\* A résumé of a paper read before the Clinical Society, General Hospital, Colombo, on 12th July, 1941.

to 5 days falls by lysis. In this series the average duration of fever was 10 days, the temperature invariably reaching normal on the tenth day and remaining normal from then onwards. No relapses were seen except in one case; the temperature rose on the 23rd day to 101.8°F. for a few hours. The blood on this day proved negative for malaria.

*Urinary symptoms.*—The urine showed no abnormality beyond a trace of albumin and a few pus cells.

*Laboratory findings.*—The agglutination tests for typhoid, paratyphoid A, B and C ('H' and 'O') and for *B. columbiensis* proved negative in every case. The clot culture was done in five cases and proved negative. The Weil-Felix reaction was done in two cases and proved negative. The average total white-cell count was 8,200 per c.mm. along with an absolute lymphocytosis, the average differential count being polymorphonuclears 58 per cent,



lymphocytes 40 per cent and eosinophils 2 per cent. Stools on culture proved negative in 4 cases in which it was done. There was no complication in the series, the patient making a rapid recovery in every case. One pregnant woman had abortion at about the sixth or seventh month during the fever.

*Diagnosis.*—In this series, 8 cases were diagnosed and treated as typhoid and the other two being diagnosed as malaria and colitis.

The diagnosis however is not difficult. It is not entirely based on negative finding. One's suspicion of typhoid is soon set aside when the headache passes off, the patient becomes cheerful and brighter from the fifth day and the fever begins to fall by lysis. The absence of toxæmia is characteristic. So also is the moderate leucocytosis with lymphocytosis and negative agglutination reactions.

*Cause.*—I am afraid I do not know the cause of this fever. Perhaps it is bacterial in origin. Further laboratory investigations seem to be necessary to trace the origin. It does not appear to be very infectious.

*Treatment.*—No definite treatment is indicated beyond symptomatic therapy.

## SULPHAPYRIDINE IN THE TREATMENT OF TETANUS

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and

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FOLLOWING its success in the treatment of lobar pneumonia, sulphapyridine came to be tried against a number of different infections including those due to the clostridium group of organisms. In fact the drug has already an important place in the treatment of gas-gangrene. Bryant and Fairman (1940) have obtained with M.&B. 693 encouraging results in the treatment of tetanus. Cole (1940 and 1942) however reports a case of tetanus in which sulphapyridine did not have any effect whatsoever against the fatal course of the disease.

During the period from December 1941 to May 1942, sulphapyridine was used in the treatment of thirty-seven consecutive cases of tetanus in the Medical College Hospital, Patna. The results obtained are reported below.

*Treatment adopted.*—The patients were nursed in a quiet and dark room of the ward. Nourishment was given in fluid form throughout the course of illness. Bowels were opened by soap and water enema as a rule, since constipation was practically always present. The wounds present were cleaned and dressed regularly. Care was taken to cut down to a minimum all nursing activities likely to induce reflex spasms and essential nursing was done only when the patient was deeply under the effect of the sedatives.

The dosage of sulphapyridine employed was one tablet every four hours for the first three days, followed by one tablet three times a day up to a total of thirty tablets.

A bromide-chloral-hydras mixture by mouth and paraldehyde my mouth or per rectum were used as sedatives. The bromide mixture containing ten grains each of chloral hydras and the bromides of potassium, sodium, and ammonium, was given every two hours for the first three days and then every four hours. (The patients were not awakened for administering the mixture.) Three drachms of paraldehyde with syrup were given in an ounce of water twice daily, or else six drachms of paraldehyde in olive oil were given twice daily per rectum.

In cases with severe spasms the above-mentioned sedatives often proved inadequate. In such cases *Evipan-sodium* was used to control the spasms if the patient could afford to purchase the drug. (This was possible in only eight cases.) Five to 10 c.cm. of a 10 per cent solution of the drug was given intravenously twice daily. The effect of this intravenous anæsthetic was kept up by intramuscular injection of 4 c.cm. of paraldehyde.



Before being warded eighteen cases had received tetanus anti-toxin in doses varying from 3,000 to 6,000 units. But as none of the patients could afford to buy the anti-toxin in amounts generally advocated for a definite therapeutic effect, it was not used in the wards.

No case in the series had taken a prophylactic injection of anti-toxin.

*Result of the treatment.*—Two cases left the hospital against advice, the results in the remaining thirty-five are given below :—

|                    |    |    |    |
|--------------------|----|----|----|
| Total No. of cases | .. | .. | 35 |
| Cured              | .. | .. | 18 |
| Died               | .. | .. | 17 |

The following table shows the results in relation to the incubation period and the severity of the disease :—

TABLE

| Day of first spasm after<br>sustaining injury | Number of<br>cases | RESULTS OF TREATMENT                       |      |             |      |           |      |       |      | TOTAL |  |
|---|--------------------|--|------|-------------|------|-----------|------|-------|------|-------|--|
|   |                    | In relation to the severity of the disease |      |             |      |           |      |       |      |       |  |
|   |                    | Mild 1                                     |      | Moderate 13 |      | Severe 21 |      |       |      |       |  |
|   |                    | Cured                                      | Died | Cured       | Died | Cured     | Died | Cured | Died |       |  |
| 1 to 7 days .. ..                             | 3                  | ..   | ..   | ..          | ..   | ..        | 3    | 0     | 3    |       |  |
| 8 to 14 days .. ..                            | 13                 | 1  | ..   | 8           | 1*   | 3         | ..   | 12    | 1*   |       |  |
| 15 days and above .. ..                       | 3                  | ..   | ..   | ..          | ..   | 3         | ..   | 3     | 0    |       |  |
| Unknown .. ..                                 | 16                 | ..   | ..   | 2           | 2    | 1         | 11   | 3     | 13   |       |  |
| TOTAL .. ..                                   | 35                 | 1  | ..   | 10          | 3    | 7         | 14   | 18    | 17   |       |  |

Mild—tonic rigidity without reflex spasms.

Moderate—reflex spasms occurring at long intervals.

Severe—very frequent reflex spasms at long intervals.

\* The patient died of measles following cure of tetanus.

*Discussion and conclusions.*—Of the eighteen cases that recovered, seven had suffered from the 'severe' form of the disease. In five of these seven cases, evipan-sodium was used to control the spasms.

Of the seventeen cases that died, three had the 'moderate' and fourteen the 'severe' form of the disease. The three deaths amongst the cases with moderate symptoms include one case that died of measles after recovery from tetanus. Of the fourteen deaths amongst the severe cases, ten occurred within twenty-four hours of the admission of the cases into hospital—a period too short to allow the drug to act in sufficient concentration. Of these fourteen cases only three could procure evipan-sodium, and only in one of these three was the anæsthetic effective in controlling the spasms, one died thirteen hours after admission to the hospital and received only one injection of evipan-sodium, and in the third case evipan-sodium was given only after the severe and

exhausting spasms had already continued for two days. Thus amongst the cases that died, there was only one case in which spasms were kept under control and sulphapyridine given a proper trial; the incubation period in this case was only five days.

If the eleven cases, one that died of measles and the ten that died within twenty-four hours of their admission, are excluded the mortality rate comes to 25 per cent, since eighteen of the remaining twenty-four cases recovered.

It is not possible to arrive at a definite conclusion from observations made on only thirty-five cases, but we feel that sulphapyridine in conjunction with evipan-sodium as anti-spasmodic will have a definite place in the treatment of severe tetanus. Moreover, this line of treatment is much cheaper than the serum

therapy if the serum is employed in the doses generally advocated\*.

A further trial is however needed in this direction before definite conclusions can be drawn.

*Acknowledgments.*—Our thanks are due to Captain R. P. Ghosh, superintendent, Medical College Hospital, for permission to publish the records of the cases. Thanks are also due to Dr. S. M. Ghosh for his valuable suggestions and untiring help.

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\* The cost of 200,000 units A.T.S.—the dosage advocated by Leslie Cole—is Rs. 150, whereas M.&B. 693 tablets for the whole course will cost Rs. 4 only. If evipan-sodium is used in addition as anti-spasmodic, it will mean an additional expenditure of Rs. 30 to Rs. 40 for the 10 ampoules that are usually needed in the severe cases.

## TRANSLUCENT AREAS IN THE LUNG FIELD

By L. EVERARD NAPIER, C.I.E., F.R.C.P. (Lond.)

and

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A ROENTGENOGRAM of the lung field varies considerably according to the intensity of the rays, the length of the exposure, and the development of the film. Normally, the lung fields appear as translucent areas which are crossed by striate markings radiating from the hilum. These linear striæ are shadows cast by the blood vessels accompanying the bronchi. They do not signify increased fibrous tissue formation or bronchial ramifications; bronchi, except the ones near the hilum, do not usually cast shadows in the roentgenogram.

In *emphysema* the lung becomes more translucent than normal, the translucency depending on the degree and extent of the process and being due to the presence of air in the distended alveoli. The striations show an increased density which is further intensified by vascular changes due to pulmonary congestion. There are other radiological features characteristic of *emphysema*, viz, the ribs become more horizontal than usual, the intercostal spaces are widened, the costo-phrenic angle is increased, and the diaphragm is flattened; the screen examination shows the limited excursions of the latter, and sometimes its outline loses the dome shape, and becomes irregular owing to basal adhesions, which, if in excess, may even obliterate the costo-phrenic angles. Owing to the lowering of the diaphragm, the apex of the heart tends to rotate forward, and therefore the heart as a whole appears small (Kerley, 1936). The inferior vena cava shadow may appear clearer in *emphysema*, presumably on account of the low diaphragm and rotation of the heart. The pulmonary artery looks prominent in the left hilum, and the right side of the heart may be enlarged.

In spite of there being so many characteristic radiological features, we do not as a rule *x-ray* a chest for the diagnosis of *emphysema*, as the clinical signs are obvious in an established case, but, if some complication is suspected, a skiagram is indicated, and other methods, such as bronchography, tomography and/or bronchoscopy, may be needed to establish a diagnosis, especially if the *emphysema* is a localized one, that is, when a local area of increased translucency is seen. When there is a well-defined local translucency, the condition may be mistaken for pneumothorax, but in localized *emphysema* the lung markings will be faintly seen in the translucent area.

Cavity formation in the lung is another cause of localized increased translucency. This may result from tuberculosis, bronchiectasis, abscess, cyst, or a growth that is breaking down. Tuberculous cavities usually have a well-defined

wall, usually with an infiltrated area around them; the more chronic is the cavity the thicker the wall. If the surrounding tissue, however, is consolidated and the overlying pleura thickened, the cavity may be missed unless serial pictures are taken with the aid of a tomograph. Non-tuberculous abscess usually casts a fairly well-defined shadow, often with a fluid level. Cysts and bronchiectatic cavities as a rule have a thin wall. They may or may not be visible in an ordinary skiagram; sometimes there may be nothing but diffuse haziness or simply an area of apparent fibrosis. Bronchography is often required to confirm the diagnosis; lipiodol enters such a cavity readily, and determines the extent of the damage. The oil usually does not reach an abscess cavity.

Ring-like shadows resembling cavitation may at times be seen in a skiagram. They have a thin well-defined wall of fairly uniform thickness, identical in appearance with that of a cyst. The density of the lung field inside the ring is, however, the same as that of the rest of the lung. They give rise to no signs or symptoms.

Various views have been expressed regarding the cause of these ring shadows. Amberson regards them as pleural rings caused by adhesions between the visceral and parietal pleura.

In other cases the ring shadows surround a translucent area. It has been suggested that these are air-pockets in the pleural surfaces of the interlobar fissure. Some hold that these annular shadows represent silent tuberculous cavities; the mere finding of such an annular shadow should not influence treatment, which should depend on the associated symptoms.

The possibility of these rings being the result of localized pneumothorax has been considered.

Mitchel (Sowerbutts, 1932) has suggested that they are *air-cysts*, the mode of their origin being as follows: a small bronchus or bronchiolus, possibly weakened by disease, becomes strained by repeated coughing and eventually gives way, allowing air to escape into the connective tissue of the lung. This causes a solitary bubble of air, which is confined to the interstitial tissues, but does not cause an interstitial *emphysema*. The compressed tissues around give rise to the annular shadow. If the perforation heals up, the air may be absorbed, with disappearance of the ring.

Other authorities consider that they are *emphysematous bullæ*, possibly of congenital origin. They are differentiated from cavities by their roundness, their extreme clarity, the absence of any fluid level, the thinness of their walls, and the absence of surrounding induration. They may however be present in cases of chronic fibroid phthisis.

They may rupture, giving rise to spontaneous pneumothorax; most cases of non-tuberculous spontaneous pneumothorax are due to rupture of *emphysematous bullæ*. Spontaneous pneumothorax occurring suddenly in otherwise apparently healthy persons is not very uncommon. Recently published studies tend to show that

the most frequent cause is the rupture of an emphysematous bulla. Such bullae have been demonstrated around scar tissue, such as healed tuberculous foci or collapsed areas. Effusion usually does not follow such a pneumothorax. Complete recovery is usual within a short time, but recurrences may occur. No treatment is ordinarily needed except rest in bed and sedatives during the first few days.

The following case is of interest in this connection :—

The patient was a European, aged 40, who, after a long spell of work in Calcutta without a holiday, had an attack of dengue. He gave a history of tiredness and lack of energy for a few months. He had been given eight injections of emetine, apparently for diarrhoea. A few days before admission he had a sudden pain in his chest over his heart which he attributed to either pleurisy or 'heart'. He said he was unable to rise from his bed at all, and when later he did so, the effort caused him to be drenched with perspiration; the pain disappeared slowly within a few days. The symptoms were more suggestive of indigestion and hypochondriasis, but we admitted him to hospital for more thorough investigation.

Clinical examination of the chest failed to reveal any abnormality, but an orthodiagram was ordered mainly to convince the patient that his heart was sound. There was no evidence of any coronary lesion.

In the absence on leave of the official radiologist, the opinion of another radiologist was obtained. He reported as follows :—

'Apart from slight ventricular predominance the heart appearances are normal.

Extreme cavitation is seen in the right upper lobe. Signs of chronic bronchitis and bronchiectasis to a lesser extent are seen bilaterally.'

Only the first half of the report was communicated to the patient.

The patient was questioned and examined again in view of this report. There was nothing in his history, except that questionable attack of pleurisy, or in the physical examinations to suggest that he had at any time suffered from pulmonary tuberculosis.

A second skiagram was taken by the same radiologist. An almost identical picture was obtained and the radiologist who had now been shown the clinical notes reported: 'See notes on previous skiagram'.

The patient was a nervous individual and we did not feel justified in communicating this report to him. He was discharged from hospital and we have been personally in touch with him for over three years, during which time he has remained in apparently sound health. He has now been in the army for nearly a year.

At our request Col. Shorten, the radiologist to Carmichael Hospital for Tropical Diseases, examined the films and reported as follows :—

'Heavy hilar shadows with calcifications in both sides; in addition, the right lung shows the following : (1) A group of large ring shadows in the right upper zone with thickened broncho-vascular trunks leading to a group of calcifications in the upper part of the hilum. (2) Surrounding the ring shadows there is evidence of a streaky fibrosis but no infiltration. (3) A streaky fibrosis in the periseptal area also extending into the hilum.

(Concluded at foot of next column)

## THE RÔLE OF METHÆMOGLOBIN ON THE LEPTOMONAD PHASE OF *LEISHMANIA TROPICA*, WITH SPECIAL REFERENCE TO ITS REVERSION INTO *LEISHMANIA* FORMS IN CULTURE

By R. ROW, O.B.E., M.D. (Lond.), D.Sc. (Lond.)  
and

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IN a former communication one of us (Row, 1922) had pointed out that the flagellate leptomonad forms of *Leishmania tropica* reverted to the leishmania O-bodies and these made their appearance in the condensation fluid of NNN culture tubes inoculated with the parasite 2 to 3 weeks previously. These were described as the O-bodies, or resistant forms, and it is the presence of these in old cultures of *L. tropica* which was responsible for their infectivity in mice—even to the extent of inducing a generalized infection in them—indistinguishable from experimental kala-azar (Row, 1914). The observation on the infectivity of old cultures containing these resistant forms was confirmed by Southwell and Kirshner (1938)\*. It was also pointed out (Row, 1922) that the reversion was due either to the concentration of the fluid or to the alteration of the oxyhæmoglobin into methæmoglobin.

Subsequent work on the culture of the parasite in the hæmoglobin saline medium of Row (1912)

\* No original investigation was undertaken by these workers; in their paper they review work already done, including Dr. Row's.

(Continued from previous column)

**Conclusions.**—These appearances are suggestive of old healed tuberculous disease.

The ring shadows in the upper zone are due to one of two causes: (a) emphysematous bullae; (b) an irregular pneumothorax with adhesions.

There is no evidence of cavitation.'

**Conclusion.**—It seems improbable that the patient had a pneumothorax, as there would have been more clinical evidence of this. We are inclined to accept the second radiologist's (Col. Shorten's) alternative opinion that the translucent areas are in this case due to emphysematous bullae.

There is little to support the first radiologist's interpretation—which he declined to revise—even on the strength of the skiagram, and when the latter was taken in conjunction with the clinical picture, this interpretation was completely ruled out. Had this verdict been communicated to the patient, the result would have been disastrous.

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proved that it was the latter condition more than the former which was responsible for the reversion, but unfortunately it is difficult to demonstrate this feature clearly, even in stained smears, because here the leishmania bodies lie scattered between the large number of flagellates overcrowding and overshadowing them in the form of rosettes which persist in the fluid culture medium even for 100 days, as pointed out elsewhere (Row, 1935), unless one is lucky to hit upon the right day while examining old cultures (*vide* figure 5), and even here the day varies with the strain of the parasite (*vide* figure 6). It was therefore thought interesting to see if any morphological alteration of the flagellates into leishmania bodies could be observed more clearly in the culture fluid containing only methæmoglobin.

*Preparation of the culture fluid.*—When the parasite of the oriental sore is grown in Row's medium (1912) and the ensuing flagellates allowed to thrive for several weeks at 22°C., the striking character of the culture fluid is its alteration in colour from scarlet lake of the oxyhæmoglobin into a brownish transparent liquid which on spectroscopic examination shows the distinct methæmoglobin absorption band in the red of the spectrum, and the disappearance of the two characteristic absorption bands of the oxyhæmoglobin between the D and E lines. The flagellates flourish in abundance and are found mostly in rosettes of more or less equal size indicating that they continue to grow even when oxyhæmoglobin is altered into methæmoglobin. After a week or two, however, the culture degenerates and consists mostly of granular debris. At this stage the brown culture fluid is centrifuged and the supernatant fluid is distributed in tubes and this constitutes methæmoglobin medium ready for immediate use.

These tubes are inoculated with a drop of young cultures of five to seven days containing only flagellates and incubated at 22°C. and when examined every three or four days reveal the following features:—

During the first week the culture shows that the flagellates have grown in enormous numbers, but is characterized by the presence of rosettes of more or less equal size uniformly distributed in the fluid (*vide* figure 1), and stained smears show that it is from these rosettes that the leishmania bodies are derived and these are found also lying between the rosettes in fair numbers with all transitional forms (*vide* figures 2, 3, and 4).

During the second week the rosettes have a tendency to mass together but slightly degenerate with a large number of oat-shaped bodies and transitional forms, obviously the product of the rosettes (*vide* figure 6). A few days later, all that is left is a degenerate debris of the leishmania bodies with a flagellate here and there.

The transitional forms are exactly like those occurring in the condensation fluid of the old NNN cultures already described elsewhere, except for the absence of the thin capsule-like structure, within which the parasites obviously appear to shrink. These transitional forms, it may be repeated, are briefly as follows:—

(1) The phase where the active flagellates become sluggish with the shortening of the flagellum by its withdrawal inside and its absorption, and with the simultaneous migration of the kinetoplast towards the nucleus.

(2) The shortening phase of the parasite where the shortened stump of the flagellum disappears and where the condensation of the cytoplasm of the parasite takes place side by side with the further approximation of the kinetoplast towards the nucleus, before the final rounding off stage when they become oat-shaped or round bodies (with the differentiation of the nucleus) indistinguishable from those found in the original lesion.

The morphological changes of the flagellates into leishmania bodies when grown in the methæmoglobin medium are illustrated in the accompanying photomicrographs.

#### Summary

(1) The reversion of the flagellates into leishmania forms can be induced in a few days by growing them in the methæmoglobin medium.

(2) The formation of leishmania forms is always preceded by the appearance of a large number of flagellates mostly in the form of rosettes (distributed uniformly in the medium) from which arise masses of transitional forms and leishman bodies.

(3) The significance of these points may require further investigation.

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#### DESCRIPTION OF PLATE XVIII

- Fig. 1.—*L. tropica* (Cambay), 12-day culture in methæmoglobin; rosette formation stage.  
Fig. 2.—*L. tropica* (Cambay), 12-day culture in methæmoglobin; rosettes going into leishman bodies and transitional forms.  
Fig. 3.—*L. tropica* (Delhi), 7-day culture in methæmoglobin; completion of leishman bodies.  
Fig. 4.—*L. tropica* (Delhi), 6-day culture in methæmoglobin; transitional forms of leishman bodies.  
Fig. 5.—*L. tropica* (Ambala), 39-day culture in Row's medium; oxyhæmoglobin altered into methæmoglobin; most of the rosettes reverting to leishman bodies.  
Fig. 6.—*L. tropica* (Cambay), over 4 weeks' old culture in Row's medium; oxyhæmoglobin altered into methæmoglobin; some of the rosettes reverting almost to leishman bodies.

## CONSTRICTION OF THE URETER

By RICHARD E. STRAIN, M.C.P.S., M.D., M.C.C.

CONSTRICTION of the ureter is 'one of the most common lesions of the abdomino-pelvic cavity' (Hunner, 1941) and is still being largely neglected not only by men in active practice but also by teachers even in the better medical schools (Brown and Pennington, 1941). The following case reports illustrate several common varieties of this common clinical condition:—

Miss Y., a 25-year-old single American, developed sudden abdominal pain of generalized aching nature during the night of 23rd December, 1940, at 2 a.m. preventing further sleep. I saw her at 6 a.m. when the pain had localized to an area to the right and slightly below the umbilicus and extending up into the right upper quadrant. Some nausea but no vomiting was present. The last menstrual period had started 14 days previously. There was no history of nocturia, dysuria, frequency or backache. Irregular acquired dysmenorrhœa had been noted in the past. A similar attack had occurred two months previously on a train trip from Calcutta and lasted a few days. The patient had shortly afterwards a routine annual physical examination by another physician and been pronounced in good physical condition. A history of 'hives' three days prior to the onset of the December attack was obtained.

Examination disclosed a temperature of 100.6; pulse 88; respiration 20. The head, heart and blood pressure, and lungs were normal. A broad sub-costal angle was noted. The abdomen was scaphoid, symmetrical; moved well with respiration, and was without visible masses or peristalsis. On palpation, definite pain and tenderness with some spasm was noted just to the right of the umbilicus and extending up into the right upper quadrant. The patient could not take a deep breath while moderate pressure was being exerted in the region between the umbilicus and right costal margin at its mid-point. Gurgling on pressure was noted in the right lower quadrant but no tenderness. The kidney posteriorly was not tender to deep pressure. Pelvic examination was negative. There was a slight leucocytosis. Urine was normal.

I felt the patient had a high retro-cæcal appendix of the mechanical (fæcalith) type. I asked Dr. R. H. H. Goheen to see the patient in consultation, as the findings were far from typical. He felt that the appendix was the cause of the trouble and immediate operation was decided upon. Under spinal anæsthesia (150 mg. of neocaine) a right rectus incision disclosed a small, non-adherent normal looking appendix; it was removed and found to contain two strictures and a fæcalith. The gall-bladder was normal; a few soft adhesions were felt about the right kidney which was slightly larger than the left. A small fibroid on the right of the uterus was removed. Convalescence was uneventful except for persistence of pain to the right of the umbilicus.

The patient was then well without symptoms for one month; we decided to cystoscope and do pyelography to discover the cause of adhesions and slight enlargement of the right kidney, but the patient wished for postponement. Two months after operation, nocturia developed once nightly and over a four-month period increased to twice each night. Dull ache was present in the right upper quadrant, the patient for relief putting a hot water bottle just below the right costal margin. At my suggestion three months after operation the patient took a full glass of cream in a diagnostic procedure. A severe attack of right upper quadrant pain requiring morphine and associated with nausea and vomiting for two days followed. There was no fever; the pulse was in the sixty's; low mid-backache associated with tenderness over the right ureter was present; some pain was also present in the lumbar area. Fluids were forced but this procedure

so much increased nausea, vomiting and pain that it was stopped. Hospitalization for immediate investigation was urged but delayed at the patient's wish. Six months after operation she entered the hospital for investigation.

Gall-bladder and stomach showed no abnormality. Three films were taken in the pyelogram series; one (figure 1) disclosed a double pelvis to each kidney. On the right was a solitary ureter with a high constriction at the utero-pelvic junction; dilatation and then a constriction at the level of the transverse process of the third lumbar vertebra. The pelvic portion of the ureter was dilated, the lower constriction not being seen. On the left two ureters were seen. Figure 2 shows the left ureters after a retrograde pyelogram.

Indirect cystoscopy disclosed a urethra tight to a 18 F catheter; this was dilated to 26 F; bladder capacity was 400 c.cm.; the bladder mucosa showed thickened muscle bundles without true trabeculation. The region of the right ureter was reddened and a small ulceration with an adherent blood clot was noted just below the orifice. Two ureteral orifices were seen on the left and appeared normal. The trigone was slightly redder than normal. Urine culture was sterile. Indigo-carmin was given intravenously (20 c.cm.) and water by mouth but a temporary anuria had persisted for seventeen hours was found; so catheterization was not done. Quinby and Austen (1939) report such anuria following intravenous pyelography. Further cystoscopies showed that a no. 6 ureteral catheter could be introduced to the right kidney easily but was tight in each left ureter. A bee's wax bulb on the catheter demonstrated 'hang' on withdrawal in the right stricture area; also in the upper left ureter four inches from the bladder.

The patient has since had repeated dilatations, one ureter being dilated at a time each week. We have dilated the right ureter to a size 24 by using one 6; two 5's; and two 4's all alongside in the ureter at the same time. During this slow process the patient has had recurring attacks of right upper quadrant pain with nausea and vomiting after dilatations; the urine has consistently been sterile before cystoscopy; she was given anti-spasmodics and bile salts without relief before dilatations were undertaken; acid also failed to relieve her; she is not now completely cured but feels 'better than I have in months'. Her nocturia is now irregularly once nightly where it was for several weeks thrice; her pain no longer incapacitates her as it once did; her left ureters have been dilated only to no. 12 and still give symptoms. Hunner (1941) at Johns Hopkins points out that dilatation should be carried up to a no. 18 and states that when multiple catheters of small sizes are used the resulting dilatation is not the sum total of the size of the catheters; this seems very illogical but is true; we have deferred to his wide experience at the John Hopkins hospital and given a large dilatation as single large catheters were not available.

Case 2.—Mrs. F., a married American woman of 25 years, was seen in March 1941, fearful that she had appendicitis because of sudden onset of cramping abdominal pain of a generalized nature preceded by constipation; associated with nausea, borborygmous flatulence, poor appetite and headache. No vomiting, diarrhœa, nocturia, frequency or discharge. Acquired dysmenorrhœa present eight months; periods lasted eight to nine days and came every twenty-three days. The last menstrual period had just been completed. In 1933 after x-rays of the chest she had spent five months in bed although she had been assured she did not have tuberculosis. Since 1938 she had been anæmic (hæmoglobin 75 per cent Sahli) and had not felt very brisk. The temperature was 98.6; pulse 90; respiration 20; blood pressure 110/70. The patient appeared anæmic; her head, lungs, and heart were normal. The abdomen was flat, symmetrical, scaphoid and moved well; the sigmoid colon and cæcum were both palpable and tender. Tenderness was present over Legge's and Morris' points on both sides but faded into cæcal and sigmoid tenderness. A fixed, retroflexed uterus was found. Chest x-rays, sputum, and

PLATE XVIII  
TRANSLUCENT AREAS IN THE LUNG FIELD : L. E. NAPIER & R. N. CHAUDHURI



Fig. 1.



Fig. 2.

THE ROLE OF METHÆMOGLOBIN ON THE LEPTOMONAD PHASE, ETC. : ROW & KULKARNI

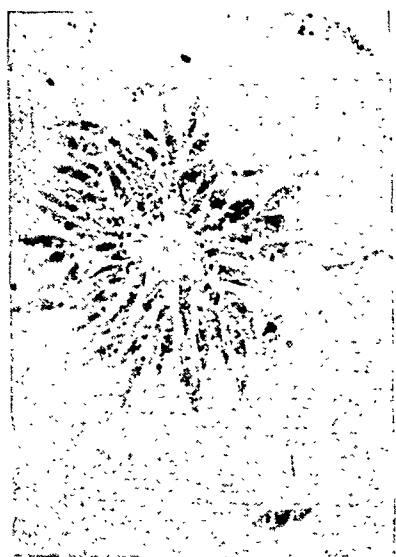


Fig. 1.



Fig. 2.

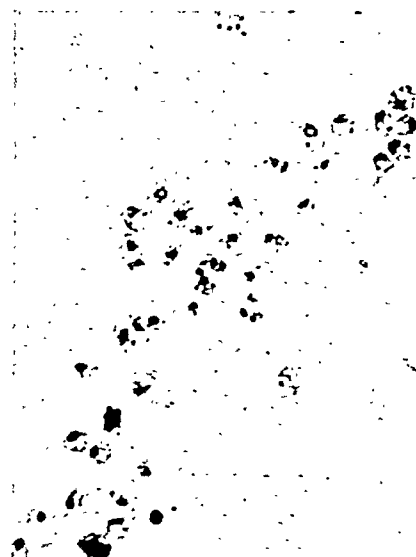


Fig. 3.

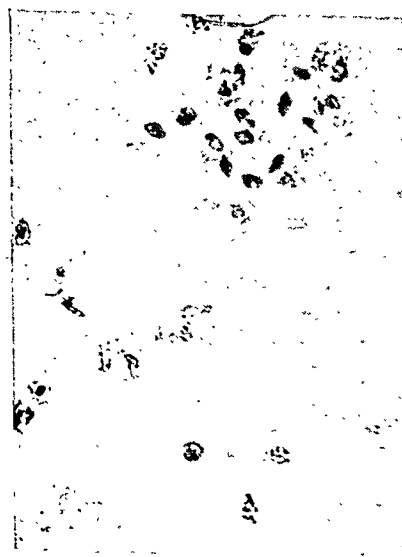


Fig. 4.

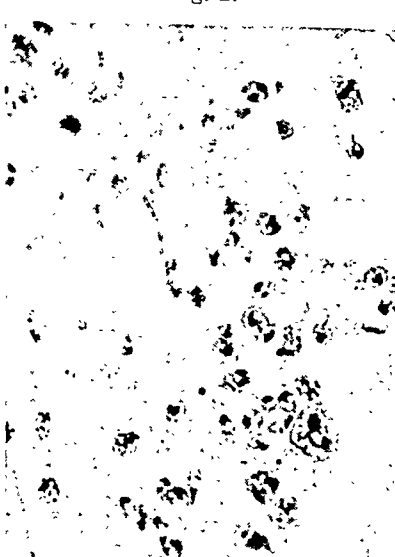


Fig. 5.



Fig. 6.



PLATE XIX  
CONSTRICTION OF THE URETER : R. E. STRAIN



Fig. 1.



Fig. 2.



Fig. 3.



Fig. 4.



Fig. 5.

tuberculin tests were negative. Entamoebae were found in the stool; agglutination tests for His bacilli were positive 1/320; negative for Shiga and Flexner. Treatment with entero-vioform relieved the flatulence but ureteral tenderness persisted. Catheterized urine showed an acid reaction; specific gravity 1.018; albumin one plus; no sugar; leucocytes one plus. Because of urinary findings and history of acquired dysmenorrhœa it was decided to investigate the urinary tract. Intravenous pyelogram was done and reported normal (figure 3). Indirect cystoscopy disclosed a urethra tight to a 18 F catheter; this was dilated to 28 F. Bladder capacity was 200 c.cm.; the bladder was dilated to 350 c.cm. A bee's wax bulb on a no. 6 catheter demonstrated 'hang' on withdrawal from the lower left ureter. Dilatation of the ureter to no. 12 has relieved completely the acquired dysmenorrhœa; there has been no recurrence during the past six months. Her urine has repeatedly been normal.

This represents a type of ureteral constriction about which such great controversy has raged. The x-ray report—normal ureterograms; the operator while passing a bulb feels a 'hang' (and quite frequently the patient gets some pain similar to that occurring previously); the other clinicians say that it is due to spasm; dilatation produces relief of symptoms so frequently associated with ureteral constriction. Significant co-existent findings lending support to the diagnosis of ureteral constriction are the constricted urethra and small bladder capacity. The average bladder will accommodate 300 c.cm. and anything below that is regarded as abnormal (Brown and Pennington, 1941). The normal urethra in a woman accommodates a 26 F catheter (Stevens, 1936, and Stevens and Smith, 1937).

Case 3.—R. B. R., aged 37, a married male, Hindu, was seen on 12th September, 1941, complaining of pain, and discharge of pus from the rectum. For ten months he had signs suggestive of pulmonary tuberculosis; for two months suppurating glands of the neck and a fistula of the rectum; for one month bloody urine and nocturia nightly ten times. He was found to have bilateral pulmonary tuberculosis with foci in the glands of the neck, a fistula-in-ano, marked anæmia, and a tender left kidney with very bloody urine. The fistula was dissected out at the patient's instance; cystoscopy disclosed a bladder capacity of 230 c.cm. with blood spurting from the left ureter; no ulceration of the bladder. Retrograde pyelograms (as shown in figure 4) showed constriction on the right side just above the bladder shadow. The left kidney emptied so quickly that we could not obtain a picture. We have been unable to isolate tubercle bacilli from the urine. Bleeding has been much less since passage of catheters but it is not felt that this man's symptoms are due to stricture alone.

Case 4.—Miss J. R., a 17-year-old single girl from Goa, was referred to me by Dr. R. H. H. Goheen on 8th July, 1941, complaining of recurring attacks of pain in the right lower quadrant associated with constipation; duration two years; pain dull aching in character without radiation. Dysmenorrhœa of the acquired type had been present three years. Nocturia was noted 'often'. There were no other genito-urinary complaints. Nausea and vomiting were absent. Examination disclosed very little except tenderness along the right ureter most marked just two-finger breadth to the right of the umbilicus. Blood, stool and urine were normal. The patient was cystoscoped by the indirect method; the urethra was tight to a 18 F catheter; bladder capacity was 200 c.cm.; moderate injection was noted about the right ureter; a no. 6 ureteral catheter met a high obstruction on the right. Further cystoscopy was refused by the patient's father on the ground she was 'too young'. Intravenous pyelograms disclosed a high stricture on the right at the utero-pelvic junction with definite pyelectasis. Further treatment was refused.

Case 5.—B. B. N., aged 23, a married male Hindu, was seen on 25th August, 1941, complaining of pain and burning in the epigastrium for six months. The patient was a strict vegetarian. He had begun to note

fullness after meals; sour eructations; nausea but no vomiting; paræsthesia of the extremities; giddiness; pain over the kidneys and nocturia one time for six months. Slight tenderness to deep pressure was present on both sides of the umbilicus at Legge's point. No kidney tenderness. The epigastrium was normal as was the rest of the body. There was slight anæmia. Stool and urine were normal. Kahn was three plus. Cystoscopy was done after sodium amytal, morphine and atropine and under caudal anæsthesia. As the patient came to the cystoscopy room, he was talking at random as if from a 'barbiturate jag' but was quite willing for cystoscopy. The bladder capacity was 250 c.c.; the mucous membrane was redder than normal with a number of dilated vessels around the right ureter. The right ureter was catheterized; an obstruction was noted three inches up from the bladder which persisted despite withdrawal of the stylet and catheter. The prostate was normal in appearance. The patient was quite restless, therefore the left ureter was not catheterized. Intravenous pyelograms disclosed the lower portion of the right ureter to be dilated; the right ureter deviated sharply at the level of the third lumbar vertebra. The left ureter was small with a sharp narrowing in the pelvic portion. The right kidney pelvis was slightly dilated. Anti-luetic treatment and dilatation were advised; both were refused. There was no evidence of ulcer of the stomach.

Case 6.—M. C., a 24-year-old single male Goanese, was seen on 10th October, 1941, and referred to me by Dr. R. H. H. Goheen with a chief complaint of recurring pain in the right lower quadrant of three months' duration, associated with nausea; induced vomiting seemed to relieve nausea. The pain was dull, aching in character, and localized to the right side lateral to the umbilicus. No cramps, fever, or diarrhœa. The patient had not had nocturia, frequency, urgency, headache, dysuria or hæmaturia. Attacks lasted three or four days and subsided. Examination disclosed a well-developed young male whose skin, head, chest, heart, extremities, rectum and blood pressure were normal. The abdomen was scaphoid, symmetrical, moved well with respiration and visible coils of intestine could occasionally be seen through the abdominal wall. No masses were seen or felt. There was slight tenderness to deep pressure on the right side midway between umbilicus and the anterior superior spine. In addition there was definite tenderness over Legge's and Morris' points on the right. Slight but definite tenderness was noted in the right lumbar area. There was no leucocytosis. A microcytic anæmia was present. Stool and urine were normal. Kahn plus two. It was felt the patient had some slight appendicular tenderness but also definite signs of ureteral trouble. A long, thin, fibrosed appendix was removed under spinal anæsthesia through a right rectus incision on 24th October. Convalescence was uneventful. On 30th October intravenous pyelograms (figure 5) disclosed definite pyelectasis on the right side; a sharp kink of the right ureter at the level of the transverse process of the third lumbar vertebra with dilatation of the ureter below the kink; a definite constriction with dilatation above the constriction at the lower end of the left ureter with pyelectasis and ureterectasis. Figure 5 shows the dilatation below the kink on the right which was recognized in other films. The patient refused any further treatment.

### Discussion

The ætiology of ureteral stricture is in a debatable stage. This hollow tube twenty-five centimetres long with a lumen four to five millimetres that should normally take a no. 10 to 12 ureteral catheter is narrowed at its origin; at the termination in the bladder and at the junction of its abdominal and pelvic portions.

Foci of infections in the head, tuberculosis, unwise use of x-rays, pelvic operations, trauma of childbirth, and peri-ureteral infections all may play a part in further constriction of this narrow tube. Others are undoubtedly congenital in origin.

The symptoms may be divided clinically into high and low strictures although they are usually associated; are usually bi-lateral; occur at all ages; and affect men and women (Rathbun, 1925) in equal numbers. High constrictions are confused with gall-bladder disease, peptic ulcer, and appendicitis. Many of these patients have had repeated operations for one or all of these diseases without permanent relief. Such a history should always lead to a thorough investigation of the urinary tract. The first step in the diagnosis is to realize that many careful men agree that ureteral constriction is one of the most common lesions of the abdomino-pelvic cavity. The second step is to realize that a negative urine examination does not rule out serious disease of the urinary tract. This is a stumbling-block for many. Only if infection occurs will the urine show positive findings. This occurs in about 20 per cent of cases; 30 per cent present no urinary findings, and the remaining 50 per cent show only a few leucocytes and occasionally albumin or casts. It cannot be too strongly emphasized that the urinalysis is of no value in the diagnosis of this disease. High ureteral strictures frequently present nausea, vomiting, fever, leucocytosis, very little or no kidney tenderness but a rather diffuse pain which cannot be localized except to one side of the abdomen. Case 1 presented such a picture in which backache, nocturia, frequency, dysuria, hæmaturia and other bladder symptoms were conspicuous by their absence. Seventy-five per cent of constriction patients have bladder symptoms which can only be elicited by very careful questioning.

Patients with constriction of the lower portion of the ureter complain of pain in the pelvis, backache and bladder symptoms of mild character. If urinary stasis has reached any marked degree, headache, lassitude, nervousness, and various gastro-intestinal symptoms such as anorexia, nausea, vomiting and flatulence are noted. So many women have been diagnosed as neurotics when such conditions exist that such a diagnosis is no longer tenable unless thorough investigation of the urinary tract has been done. Hunner (Brown and Pennington, 1941) feels at least 50 per cent of cases of acquired dysmenorrhæa are due to ureteral constriction; many patients have symptoms only during menstruation.

Examination in ureteral constrictions may reveal four points of tenderness on each side. Legge's (1926) point situated a finger breadth lateral to the umbilicus; Morris' point one finger breadth lateral to the mid-line at the level of the anterior superior spine; tenderness 1.5 centimetre lateral to the supra-vaginal cervix in

the broad ligament region; and finally kidney tenderness. In searching for ureteral tenderness the palpation must be deep, rolling the ureter against the vertebral bodies at Legge's point and against the sacro-iliac joint at Morris' point. If properly searched for, tenderness is usually present.

To summarize: high constriction gives a history suggestive of gall-bladder affection, peptic ulcer or appendicitis, while low constriction gives pelvic pain, backache, and bladder symptoms of such mild character as to be regarded by the patient and some physicians as falling within normal limits. Many of these patients have had repeated operations without relief, or have been diagnosed as neurotics. The most constant physical sign is ureteral tenderness. Palpation must be deep if this is to be properly elicited. The urinalysis is of no value in the diagnosis.

Cystoscopy and pyelograms confirm the diagnosis. Eighty-five per cent of cases of ureteral constriction have a constricted urethra and a bladder capacity of less than 300 c.cm. Multiple constrictions in the same ureter are not uncommon. Shortly after introducing the catheter, an obstruction may be met; this is usually due to a stiff stylet in the catheter. When this is withdrawn a short distance, the tip of the catheter assumes the natural ureteral curvature and one may proceed. Ordinary bee's wax which has been melted is used to apply a bulb two or three inches from the tip. 'Hang' on withdrawal and pain of a nature recognized by the patient will aid in the diagnosis of early constriction. In high constriction a bulb is placed near the tip of a whistle-tip variety of catheter. Extreme care is essential in passing catheters in high strictures as a sharp angulation may exist and puncture of the ureter result. In two-thirds of cases with constriction, passage of a no. 7 catheter alone will not recognize the stricture. Pyelograms should be interpreted by the man who has passed a bulb as 'hang' on withdrawal frequently tells one where to look in the ureterograms—otherwise many early constrictions will be missed. Hager and Braasch (1941) point out 'the inherent nervous control of the ureter, which has to do with peristalsis, can be stimulated by local irritation; as a result, localized areas of spasmodic constriction may cause not only obstruction to the ureteral catheter or bougie but also variable dilation above and below the point of irritation. This is apparent in the pyelo-uterograms'. I believe that such spasmodic constriction always precedes the formation of a stricture of the ureter and that many of the cases over which arguments have raged regarding x-ray interpretation and 'hang' of a bulb are simply cases seen early in the stage of the disease; they have symptoms; they have a constriction which is best recognized by a bulb; they are relieved by dilation; anti-spasmodics will not relieve their symptoms; but it is correct to say that they do not yet have a stricture. I would so regard case 2 which was relieved of

an acquired dysmenorrhœa by one dilation and has had no recurrence for eight months. Such successes are few; many writers have emphasized that if one is in quest of spectacular results, one will be disappointed as it is only after much drudgery by both physician and patient that relief is obtained.

12.5 per cent sodium iodide is given for the retrograde pyelogram and any of the intravenous preparations are satisfactory. Crane (1939) and Dolan (1940) report deaths from the intravenous preparations so it is wise to test for iodine sensitivity by having the patient hold 1.2 c.c. of iodine containing solution in the mouth for ten minutes.

Treatment is by dilation; only one ureter should be dilated at a time as traumatic œdema may cause anuria. Both ureters are usually affected; a ureter should not be dilated oftener than once a week. Patients will usually have a moderate to severe reaction within two or three days of dilation. This is of definite value in further substantiating the diagnosis, as a normal ureter should have little or no reaction after passage of a catheter, while in ureteral constriction over half (Hunner, 1941) have a reaction designated as 'bad', 'extremely severe', or 'terrible'. Reactions consist of pain, fever, nausea and vomiting. It is possible that nausea and vomiting may be associated with dilation and reverse peristalsis of the ureter as Alvarez (1940) believes it is with the bowel. Sodium amytal, morphine with atropine and tissue extracts are ordered immediately after dilation, while hot water bottles are placed over the ureter. Fluids are forced only after one is certain that drainage is present. Dilation should be carried out to no. 18 and occasionally dilation to a no. 24 F (Lowsley, 1936) may be needed.

#### Summary

Ureteral constriction is a common lesion of the abdomino-pelvic cavity which is daily being missed because this diagnosis is not thought of.

The urinalysis is of no value in diagnosis of the lesion.

Ureteral tenderness is almost always present.

The findings of a contracted urethra, a small bladder capacity and 'hang' on withdrawal of a bee's wax bulb on a ureteral catheter should make one extremely suspicious of ureterograms reported as normal.

The presence of acquired dysmenorrhœa should lead to thorough investigation of the urinary tract, as should a complaint of symptoms suggestive of gall-bladder disease, peptic ulcer or appendicitis unrelieved by operation.

Patients with abdominal complaints diagnosed as neurotic should always have a urinary tract investigation.

Cystoscopy and pyelograms are essential in diagnosis.

Treatment is dilation—only one ureter being dilated at a time. Dilation should be carried to a no. 18 F in all cases and to no. 24 F in

(Concluded at foot of next column)

## SPIRILLUM MINUS INFECTION ACQUIRED FROM AN INDIAN SQUIRREL (SCIURUS SP.)

By B. M. DAS GUPTA

Department of Protozoology, School of Tropical Medicine, Calcutta

SYMPTOMS similar to those caused by the bite of rats may follow the bites from other animals. Thus Futaki and Ishihara (Izumi and Kato, 1917) each discovered a spirochæte from cases of cat-bite fever and the identity of this

(Continued from previous column)

those unrelieved by the smaller dilation. Several cases presenting a varied clinical picture and seen within the space of a few months have been presented.

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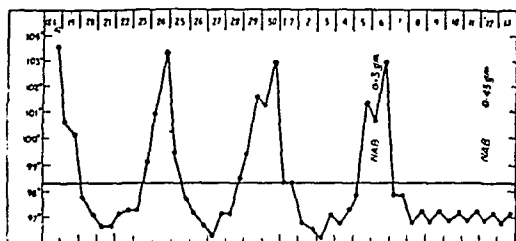
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#### DESCRIPTION OF PLATE XIX

- Fig. 1.—Case 1. Intravenous pyelograms 10 minutes after the dye showing a double pelvis to each kidney; one ureter on the right with a constriction at the utero-pelvic junction; a constriction at the transverse process of the third lumbar vertebrae; and a dilated pelvic portion of the ureter. A double ureter is seen on the left.
- Fig. 2.—Case 1 showing the left kidney's double pelvis and double ureters after retrograde pyelograms.
- Fig. 3.—Case 2 taken 30 minutes after intravenous pyelograms showing bi-lateral pyelectasis and only suggestive narrowing of the pelvic portion of the left ureter. A constriction was demonstrated in this area by the use of a bulb and dilatation has relieved symptoms.
- Fig. 4.—Case 3 showing a constriction of the right ureter 10 minutes after dye was injected by the retrograde method. The left kidney emptied so quickly it was not visualized on any of the films.
- Fig. 5.—Case 6. Intravenous pyelograms 30 minutes after injection of dye showing a sharp medial deviation of the right ureter and narrowing of the pelvic portion of the left ureter.

organism with the spirillum of rat-bite fever was established.

Ripley and van Sant (1934) describe two cases of 'rat-bite fever' acquired from a dog. One of the patients contracted the infection by mere contact with infected tissues. Mice inoculated with the blood of the patient showed spirilla in their blood. A patient suffering from nerve syphilis was inoculated with the blood of the infected mouse and developed typical symptoms of rat-bite fever.



Iyer (1936) records a case of monkey bite which developed a clinical condition exactly like that of rat-bite fever. The causal organism was not isolated, but the patient recovered after treatment with neosalvarsan.

Dick and Tunnicliff (1918) have noted that a boy who was bitten by a weasel developed a relapsing fever with eruptions and lymphangitis. The inoculation of patient's blood into guinea-pigs proved negative for spirochaetes. Blood cultures made at the height of fever gave a growth of a gram-negative streptothrix.

Smallwood (1929) reports a case of 'rat-bite fever' from the bite of a pig. The disease was diagnosed on clinical grounds. The patient showed an uninterrupted recovery following an injection of 0.6 gm. novarsenobenzene.

Schottmüller (1914) describes a case of a woman who was bitten on the forefinger and the thumb by an African squirrel (*Taraxerus cepapi*). In addition to the usual clinical symptoms the patient developed little nodules in one eye. These increased in size and completely destroyed the sight of that organ. Later on, the animal bit another man but no untoward symptoms developed in this case. A streptothrix which he named *S. taraxeri cepapi* was cultivated from the eye lesions.

Nixon (1914) reported a case of 'rat-bite fever' caused by a ferret. Apparently no attempt was made to isolate the causal organism. On looking up the literature, the author found that a similar case had previously been described.

The present case is that of a boy of 12 years; he was bitten on the finger by a squirrel, while attempting to catch it. The wound healed up in a few days. About two weeks after the bite, he had a sudden attack of fever. The area round the site of the bite became tender and cedematous, and the axillary glands of the same side were enlarged and painful. The patient came under the writer's observation on 18th June, 1942, about 6 weeks after the bite. A four-hourly chart has since been maintained and

animal inoculations were made as a diagnostic measure.

On 18th June when the patient had high fever (103.8°F.)\*, 6 c.cm. of blood was obtained and inoculated into two young guinea-pigs of the same litter, weighing 102 and 106 gm., respectively. Next day when the patient still had fever, 4 young mice (*Mus musculus*) born on the same day were inoculated intraperitoneally each with 0.25 c.cm. of blood. The blood and peritoneal fluid of these mice were carefully examined in view of the possibility of natural infection with *Spirillum minus*. From the 10th day of inoculation, the peritoneal fluids of all these animals were examined daily. On 14th July the guinea-pig showed an infection with the spirillum, but the other guinea-pig has proved negative till the day of writing this note (16th July).

Of the 4 mice, one became positive for spirilla on 3rd July, 2 others on 6th July, and the remaining mouse is still negative.

One injection of 0.3 gm. novarsenobillon caused the fever to disappear. Another dose of 0.45 gm. was given after a week to prevent a relapse.

*Comments.*—No spirillum but a streptothrix was isolated from Schottmüller's case. Serious eye symptoms, which were a conspicuous feature in Schottmüller's case, were totally absent in the present one. The incubation period in the inoculated animals was unusually prolonged and the animals, although of the same age and receiving same dosage of infected blood, were not equally susceptible to the infection.

### Summary

Reference is made to the fact that the bites of animals other than rats may give rise to 'rat-bite' disease.

A case of *Spirillum minus* infection following the bite of an Indian squirrel (*Sciurus* sp.) is recorded.

My thanks are due to Dr. A. K. Hazra of Messrs. Bengal Chemical and Pharmaceutical Works, Calcutta, for kindly supplying me with the mice used in this experiment.

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\* Axillary temperature.

## A Mirror of Hospital Practice

### A CASE OF SPONTANEOUS DISLOCATION OF HIP JOINT FOLLOWING TYPHOID ARTHRITIS

By A. K. GUPTA, M.B., B.S.

(From the Department of Surgery, Medical College Hospital, Patna)

R. S., male, 36 years, was admitted to the Medical College Hospital on 24th October, 1941, for the treatment of dislocation of the left hip joint.

*History.*—Patient had typhoid fever in December 1940 and was confined to bed till the first week of May 1941. During the later part of his ailment he used to keep his lower limbs in flexed position. About the middle of May he noticed that his left lower limb was shorter than the right. He was subsequently treated in a mofussil hospital for dislocation of the left hip joint and manipulative reduction was attempted without success.

*On admission.*—Patient of average build; afebrile. Pulse 80 per minute. The left lower limb was in a position of flexion, adduction and inversion. There was real shortening of 2½ inches. The femoral head could be palpated posteriorly in the gluteal region. Extensive scarring was present in the left buttock. No fluctuant swelling was detected anywhere. Telescopic test was negative.



Skiagram of left hip joint.

A clinical diagnosis of spontaneous dorsal dislocation of the left hip joint was made.

*Progress.*—From 15th November the patient started running a temperature of 99°F. to 101°F. On 20th a fluctuant swelling appeared over the left gluteal region. An exploratory puncture was done on 22nd.

*Investigations.* 1. X-ray on admission—Dorsal dislocation of the left hip joint and inter-trochanteric fracture left femur. No acetabular deformity shown.

2. Sedimentation rate on admission—First hour 23 per cent; second hour 37.5 per cent.

3. Exploratory puncture of the fluctuant swelling—20 c.cm. of serous fluid withdrawn.

Culture—*B. typhosus* isolated.

4. Wassermann reaction was done on admission to exclude syphilis and was negative.

#### Summary

1. A case of spontaneous dislocation of the hip joint following typhoid arthritis is reported.

2. Arthritis must have developed during the course of enteric fever and was responsible for the prolonged confinement to bed.

3. Arthritis led to adoption of the characteristic attitude of the lower limb referred to above.

4. The scarring noticed in the region of left buttock was responsible for the negative telescopic test and failure of manipulative reduction.

5. The manipulation apparently caused the inter-trochanteric fracture.

6. There is evidence of the occurrence of arthritis for the second time which may be due to lighting up of a quiescent focus.

#### Discussion

The interest of the case lies in its extreme rarity. Watson Jones in a series of 27 cases of spontaneous dislocation of hip did not report a single case occurring as a sequel of typhoid arthritis. In Bihar not a single case has been reported so far.

Another point of interest in the case is the complete absence of acetabular deformity or any bony changes in the femoral head in the radiogram, a fact which makes it difficult to explain the occurrence of dislocation. Lamy in reporting spontaneous dislocation in two cases of pneumococcal arthritis suggested that the roof of the acetabulum is softened though not destroyed so that it cannot support the femoral head. Watson Jones maintains that dislocation can occur without bone destruction. The exciting cause of luxation is muscular action deranged as a result of muscular spasm and muscle atrophy being unequally distributed in different muscle groups. Arthritis of the hip if untreated almost inevitably results in flexion and adduction deformity and it is this position which is most favourable for dislocation of the joint.

#### Acknowledgments

My thanks are due to Captain R. P. Ghosh, superintendent, Medical College Hospital, Patna, and Captain N. Pal, F.R.C.S.E., professor of surgery, for permission to publish the records of the case.

### REPEATED RESPIRATORY FAILURE IN A NEW-BORN BABY

By S. K. DUBEY, M.B., B.S.

Assistant Surgeon, Bengal-Nagpur Railway, Titilagarh

ON 23rd August, 1939, I was called to attend a case of obstructed labour at about 3 o'clock in the morning. The patient was a primipara of about 19 years of age and of a good constitution. She had marked oedema of both feet—duration about 2 months. Her urine had never been examined but the marked diminution in the quantity had been noticed by the relatives for some time. The patient was suffering from a severe type of eclampsia. The fits were very frequent and severe, and there was a marked degree of cyanosis. The patient had been given an injection of morphia gr. 1/2 at about 1 a.m. by a local doctor, but it had failed to produce any effect either on the number or on the severity of the fits.



**Examination.**—Pulse was 130 per minute, temperature 103°F., cystolic blood pressure 140, diastolic 110 mm. of mercury.

The patient was in the second stage of labour. Uterine contractions were weak and ineffectual. There was no obstruction anywhere in the passage, as the foetal head was in the perineum. But there had been no progress of the head for some time.

An injection of pituitrin 0.5 c.cm. was given, and healthy good-sized but asphyxiated female child was delivered in about 8 minutes after the injection at 5 a.m. The child started breathing normally after she had been given artificial respiration for about 15 minutes. She was then given a hot bath and handed over to the *dai*. In the meantime, the mother was cleaned, dressed and otherwise attended to. The delivery, however, did not seem to produce any effect on the eclamptic fits, so I advised the relatives of the patient to have her moved to the B. N. Railway hospital at Titilagarh of which I am in charge. When preparing to leave, I noticed the child had stopped breathing again. She did not start breathing again until after half an hour of vigorous artificial respiration. The mother and the child were then brought to our hospital at about 7 a.m. The mother was put in a modified form of Stroganoff's treatment, but her condition gradually became worse and she expired at 11 p.m. that night.

The child had an attack of respiratory failure at 8 a.m. Another at 11 a.m., then at 2 p.m., and again at 5 p.m. that day, and every time it lasted for about 45 minutes. Injection of adrenalin, atropine and strychnine was tried without any result. In the night the child had three similar attacks. Next morning I tried to give a feed of glucose water by mouth at about 8 a.m. but respiration failed again. So all feeds by mouth were stopped. But the stoppage of food by mouth did not have any effect on the number of attacks. More attacks occurred at 10-30 a.m., 3 p.m. and again at 5 p.m. when glucose was tried per rectum. As any disturbance seemed to bring in an attack immediately, attempts at artificial feeding were stopped. The child continued having similar attacks of respiratory failure 6 to 8 times on an average in the 24 hours for the next 2 days, also every time requiring approximately three-quarter hour's vigorous efforts to resume normal respiration.

If the child happened to be crying or moving her hands and feet she would at once lose her voice and all movements of hands and feet would stop when an attack came. The eyes would remain open if the child happened to be awake. Gradually all the limbs would come back to their supine positions. The mouth and eyes would slowly close. Then the face and the whole body would turn blue.

The child went on without a feed for fully 4 days. On the fifth day I arranged a wet nurse, but the child would not suck and breathing would again cease. Breast-feeding was tried twice and on both the occasions the baby stopped breathing. On that night the child had only one attack. We had given up all hopes about her life, but to everyone's surprise, the child took a good breast-feed on the sixth morning without any incident. Since then her progress has been uneventful.

**Discussion.**—The nature of the attack and the onset suggest some toxic cause with profound action on the nerve centres of the child. I am definitely of the opinion that the condition could not have been due to the injection of morphia given to the mother 3 or 4 hours before the delivery, as the rate and depth of respiration were quite normal in between the attacks. It was not due to partial atelectasis of the lungs either, as the air entry into the lungs was quite free. Most probably the eclampsia of the

mother was responsible for the condition of the child as no other cause could be found. The labour was not unduly delayed, there was practically no moulding of the scalp. Head injury as a factor appears to be ruled out. Points of interest in this case are:—

1. The number of attacks of respiratory failure although normal breathing had been established.

2. The suddenness of onset and the long duration of the attacks.

This is the first case of the kind I have ever seen. I venture to publish this case report as it would, I presume, be of interest to many, because of the rarity of the condition.

#### Acknowledgment

My thanks are due to Dr. A. W. J. Morgan, chief medical officer, and Dr. M. N. Sarkar, district medical officer of the B. N. Railway, for kindly permitting me to report the case and also to my staff of the hospital for the untiring help in the constant supervision and treatment of the child.

#### RETENTION OF URINE IN A NEW-BORN

By M. L. DIDI, L.S.M.F.

Chief Medical Officer, Kumarsain State (Simla Hills)

I was called on to see a newly-born female child on 29th June, 1942, who did not pass urine since her birth on the 24th. On examination the vulva was found much congested; thick muco-purulent discharge could be noticed escaping from the external urethral orifice; and the parts round about the external urethral orifice appeared to be sloughing. Enquiry did not show the mother as suffering from any venereal disease, nor did the father admit of ever having had it. The discharge was not examined microscopically for want of facilities. However, it was believed that the infection had crept up due to the unclean handling by the untrained rustic *dai*, or it might have been contracted on account of the extremely unhygienic and insanitary conditions. The baby was extremely restless, crying continuously.

India rubber catheter no. 4 was passed, and about three drachms of semi-viscid yellow urine was evacuated. This made the child absolutely calm and quiet. As a curative measure sulphanilamide was administered in one-grain doses well crushed and dissolved in a little milk every six hours by mouth, and locally hot potassium permanganate compresses were given.

Next day, *i.e.*, on the 30th, the father of the child reported that she passed urine twice after catheterization and that there were no more signs of distress. Sulphanilamide and hot compresses were repeated as above.

Afterwards I was told that the child was all right, with no signs of inflammation of the remaining genitals.

The points of interest in this case are urethritis in a new-born child of parents free from any venereal ailment, retention of urine from the very birth, absence of relation between the quantity of urine retained and the agony experienced, appreciable tolerance to sulphanilamide of the baby of such tender years, and the speedy recovery as a result of the treatment stated above.

## Indian Medical Gazette

SEPTEMBER

## THE KIDNEY IN MALARIA

LITTLE attention has been focused on the pathological effects of malarial infection on the kidneys. The attitude of the experienced practitioner in the tropics has been that transitory albuminuria is common, as it is in any febrile disease, and that this 'febrile' trace of albumin probably indicates some cloudy swelling of the parenchyma cells of the kidney, a condition that is usually found when such a case comes to the post-mortem table. This is not an indication of nephritis, and, though it may persist throughout the febrile period, it will usually disappear, apparently leaving no permanent damage behind.

In some cases, however, this albuminuria persists, indicating that the damage done is of a more permanent nature, and a form of subacute nephritis is visualized, which again is sometimes seen post mortem. This subacute nephritis is observed in infections by any plasmodial species, but the practitioner has been taught to expect it in quartan infections, is therefore usually on the look out for it in these infections, and retains the impression that nephritis is mainly associated with *Plasmodium malariae*.

The textbooks are similarly vague about the kidney lesions in malaria, but they all maintain the tradition, which was originally of course based on past investigations, that nephritis is almost solely associated with quartan malaria. We have not been able to find many references in medical journals to this subject, but in 1891 Marchiafava and Bignami reported glomerular nephritis in quartan malaria, and, in 1912, Clark went as far as to say that in the tropics albuminuria was an indication for searching for quartan malaria parasites, or for syphilis!

Deeks (1916) working in the Panama Canal zone, considered that nephritis was one of the commonest complications of malaria; it usually responded to treatment with quinine. Manson-Bahr and Maybury (1927) observed the association of nephritis with quartan infection in two patients and treated them successfully with quinine.

Giglioli (1930) working in British Guiana, reported albuminuria in 25 per cent of 550 cases of malaria, 25 per cent in benign tertian, 20 per cent in malignant tertian and 46 per cent in a much smaller number of cases of quartan infection. The frequency increased with the duration of the infection and was more common in relapses. He observed the following sequence in chronic relapsing benign tertian and quartan malaria; 'fever with normal urine; fever with

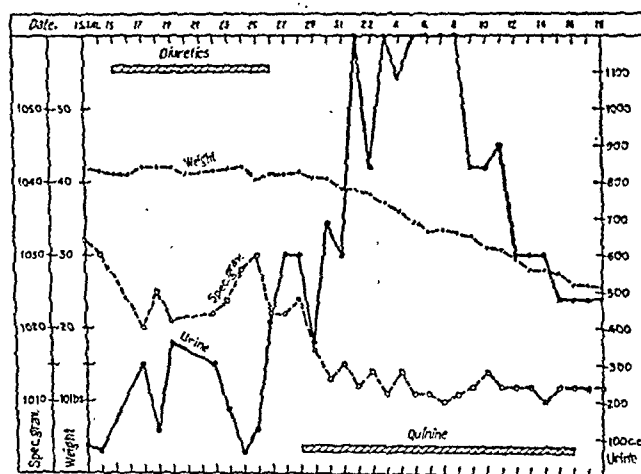
intermittent albuminuria; fever with persistent albuminuria, casts, leucocytes and renal elements in the sediment; fever and subchronic nephritis with dropsical symptoms; and chronic parenchymatous or chronic interstitial nephritis'. During seven years' observation, he encountered 102 cases of nephritis, mostly presenting chronic dropsical or interstitial nephritis. He obtained good results by treating these patients with quinine.

On the other hand, Allen (1928) reported degenerative changes in the tubular epithelium in 46 per cent of post-mortem examinations in cases of malignant malaria.

In India, the occurrence of albuminuria has often been reported, but there has been a tendency to associate it with quinine, and Sinton and Lal (*I. J. M. R.*, 12, 47) reported that if alkalies were taken with quinine, this toxic effect of the alkaloid was reduced.

Interest in this subject has been revived by Heilig (*I. M. G.*, 76, 519) who reported that in four out of six cases of acute glomerulo-nephritis there was a clear association with malaria, and that all these four cases responded well to treatment with quinine, whereas the other two patients were discharged with evidence of permanently damaged kidneys. He has followed up this observation by making a careful study of this pathological aspect of malaria and a report of his recent observations is included in this number of the *Gazette* (see p. 513).

His main evidence of the malarial origin of the subacute glomerular nephrosis which he described is the response to quinine; this is certainly very striking and is shown graphically in the figure below which is based on the data Professor Heilig and his collaborator have given in their paper.



Graph showing diuretic effect of quinine in a case of glomerular nephritis.

Suggestions have been made regarding the mechanism of production of the condition; perhaps the most plausible one is that it is an allergic phenomenon due to previous sensitization of the kidney, in susceptible individuals, by

'foreign' protein substances derived from parasite and host-tissue destruction resulting from the malaria infection and its cure.

The belief that *Plasmodium malariae* is the only species that causes nephritis is being steadily undermined, and it is quite evident that *P. falciparum* can also produce as serious changes in the kidney. Professor Heilig believes that *P. vivax* was the responsible parasite in his cases, but as in most malarious countries mixed in-

fections are the rule this conclusion must be examined more closely.

Nephritis is by no means an uncommon condition to encounter in practice in malarious districts, and now that attention has again been drawn to it, perhaps further studies will be undertaken, but it is hoped that these will not take the form of indiscriminate administration of quinine, of which there is already an acute shortage in this country.

## Special Article

### THE FUNCTIONS OF A CENTRAL MATERNAL AND CHILD HEALTH DEPARTMENT

By JEAN M. ORKNEY, W.M.S.

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THE Central Advisory Board of Health at its second meeting in Madras in 1939, in adopting the report of the special committee on maternity and child welfare work in India stressed the fundamental importance of appointing in each province and state a senior medical woman to organize and direct maternity and child welfare. The principle of a government agency to consider the problems and welfare of mothers and children, and to further the interests of this vitally important section of the nation's resources has therefore been accepted and no further advocacy for the establishment of such agencies seems necessary. A logical sequel to the appointment of medical women at provincial headquarters is the establishment of a department for maternal and child health with the central government. It may therefore be timely to ask what are the functions of such a department, what services can it render to the nation, and what organization is required to carry out the duties?

Central federal or dominion departments dealing with child health and welfare have already been established for example in the U.S.A. and Canada, and, while neither the field of activity nor the organization of these departments may be exactly applicable, a brief account of the organization and activities of the children's bureau, U.S. Department of Labour and the Child Hygiene Department of the Dominion Health Department, Canada, may serve as a guide in planning for India.

The children's bureau is under the U.S. Department of Labour; the chief is a lay woman and the assistant chief a physician. The bureau at the time of its establishment in 1912 was directed by Congress 'to investigate and report on all phases of the welfare of infants, children and young persons under 18 years of age especially infant mortality, the birth rate,

orphanage, juvenile courts, desertion, dangerous occupation, accidents and diseases of children, employment, legislation affecting children in several states and territories'. The field of activity of the bureau is gigantic; it deals with the child of every age, at home, at school, in industry, with the normal child and the child who is handicapped either physically, mentally or socially.

The work of the bureau is carried out through divisions each of which is in the charge of a technical director, who may be a physician, a social worker, a psychologist, an orthopaedic surgeon according to the nature of the work. Each director is assisted by a technical staff and an advisory committee of experts which meets annually. The divisions include the maternal and child health division, crippled children, child welfare, delinquency, industrial, editorial divisions as well as divisions for statistical and clinical research and a public health nursing unit. In addition to acting as a central office for the collection and dissemination of information, the bureau has been charged with the administration of central federal laws affecting child welfare, and with the distribution as grants-in-aid of certain monetary allocations under the Social Security Act.

The child hygiene department in Canada is simpler in organization, and the scope of activities is more limited. It is an integral part of the Dominion Health Department, and the director is a physician. He is assisted by two advisory committees of specialists, one for maternal hygiene and one for child hygiene. The recommendations of these committees are submitted for discussion at the bi-annual meetings of the public health advisory committee before being put into practice; thus the schemes are backed both by the public health authorities and by the leading members of the medical profession. The central department is wholly advisory and no grants-in-aid are provided from Dominion funds.

Stated briefly in the words of an admirable pamphlet *The Children's Bureau, Yesterday, Today and To-morrow* published by the U.S.

Department of Labour, the specific functions of the bureau are to *investigate*, to *report*, to *administer* and to *consult*. To these may be added to co-operate with other agencies and organizations, national, international, voluntary and official. These functions are discussed in subsequent paragraphs in relation to requirements in India. Considerable use has been made of the publication *The Children' Bureau, Yesterday, To-day and To-morrow* in preparing this note.

*To investigate.*—A central office for the collection of information on all aspects of maternal and child health is unquestionably necessary if the newer developments in other countries are to be made readily available in India, if the facts about maternal and child life and health in India are to become more accurately and more widely known, and if legislation relating to maternity and child welfare is to be relatively uniform. Statistical data are collected by the provincial health and census departments, but there is much variation in the procedures adopted, in the forms used in recording data, and in the completeness of the returns, which make advice and stimulation from a central department desirable.

Provincial returns require to be compiled, correlated and analysed, and the reasons underlying differences in birth rates, mortality and morbidity rates in the different provinces and districts studied and brought to the notice of the local authorities. Much of the statistical and field investigation will have to be done locally, but advice in planning the studies will be needed to prevent needless reduplication and to ensure full utilization of previous experience.

Apart from statistical investigations, the central department, whether or not it has the control of funds for carrying out special researches on maternal and infant mortality and morbidity, child development and nutrition, or for administrative studies in the field, should have an important rôle to play in advising on the nature and directing the lines of scientific research in this special field.

Actually since 1936 several of these functions have been carried out in India by the Maternal Mortality Advisory Committee of the I. R. F. A. A voluntary organization, the Maternity and Child Welfare Bureau, Indian Red Cross Society, acts at the moment as the co-ordinating link between the research association, the health departments and the field workers in M. & C. W. The Maternal Mortality Advisory Committee, apart from advising on research, has prepared a pamphlet on the conduct of maternal mortality enquiries, has made several suggestions for the improvement of vital statistics relating to stillbirths and neo-natal deaths, for the use of fresh milk mixtures in infant feeding, and has under consideration the preparation of a pamphlet on the conduct of infant mortality enquiries. In this committee there exists the

embryo of a technical advisory committee to a central department for maternal and child health.

*To report.*—A natural corollary to the collection and analysis of facts and figures is the interpretation of the data and the preparation of material which will make available the knowledge gained not only to public health authorities and the medical profession, but also to the general public and to individuals, groups and committees interested in or engaged in promoting maternal and child health.

A good deal has been done by the M. & C. W. Bureau, Indian Red Cross Society, to provide leaflets, pamphlets, folders, posters and other popular material for the guidance of individual parents in the nurture of their children, but even in this field much remains to be done if the knowledge is to be brought home equally to illiterate and literate parents. The preparation of popular articles, broadcast talks, and other literature interpreting the tables of the statistician in terms easily understood by the general public and lay authorities responsible for health has not, however, received the attention necessary if the public conscience is to be awakened to the vital importance of expanding the services caring for the mother and her children—nor have the channels for getting such material across been sufficiently developed. Very little has been done towards the preparation of scientific articles for publication in medical journals and for use by the medical profession, and while the M. & C. W. Bureau, I. R. C. S., has a certain amount of semi-technical material for the guidance of local activities, groups and committees responsible for the organization and administration of the maternity and child welfare services, progress could be greatly speeded up by the extended use of directive circulars, maps, charts, graphs and other technical material. In this field there are vast uncharted areas, which will not be filled in until the preparation of popular, semi-technical and technical and scientific material receives the attention it merits, and until the material is made readily accessible to individual parents, to the general public, to lay administrators, to voluntary organizations, to the medical profession and to experts in other fields of social service.

*To consult.*—The consultation service of the Maternity and Child Welfare Bureau is one of the better developed of its activities, and there is every reason to believe that an even wider field of usefulness in this direction would be open to a central department for maternal and child health. The problems for which advice is sought range at the moment from the individual difficulties of individual parents, to the administrative difficulties of local committees, industrial concerns, local authorities and government departments. The problems cover the whole field of maternity and child welfare, in its widest sense. Many of the requests for advice can be met by supplying popular and

semi-technical publications, others by correspondence, others only by studying the problem on the spot and after personal consultation with the authorities concerned. As the provincial maternity and child welfare services develop, the nature of the assistance required is likely to alter. Less time may be necessary to meet personal needs or the problems of small local schemes, but more consultation will be necessary for instance in planning the organization of larger schemes, for the training of personnel, and for the carrying out of enquiries into special problems and conditions affecting health. In order to give a worth-while service, it will in many instances be necessary to study local conditions at first hand, and to depute a member of the staff of the central department to make statistical and field surveys on which sound recommendations can be based.

*To administer.*—The provision of grants-in-aid of provincial schemes would carry with it various advantages in stimulating and controlling the development of maternity and child welfare, but even in the absence of grants, a central department could provide the stimulation and impetus needed. Of more importance is the provision of a central appropriation for special purposes, for example for the employment of experts to carry out special studies in the administrative or clinical fields, for the training of personnel, the appointment of special staff at provincial headquarters, the establishment of model demonstration and experimental units, for the holding of conferences and for research.

*To co-ordinate and co-operate.*—Co-operation in the *international* sphere with foreign governments and with organizations such as the League of Nations requires a central department for maternal and child health in India if the maximum potential mutual benefit is to accrue. Here again the Maternity and Child Welfare Bureau, Indian Red Cross Society, serves in some measure to bridge the gap by supplying replies to questionnaires and other requests for information and publicity material from foreign and international agencies. In the reverse direction the resources of a voluntary organization are more limited. The volume of publications received embodying the experiences and practices in other countries is not regular or automatic, and the channels for the passing on information about internationally and nationally accepted standards and procedures, particularly those of a technical nature, are ill developed. Government departments automatically receive such particulars, but at present much information that would be useful to India is filed away with other government records without being brought to the notice of the executive health authorities.

In the future, co-operation in international health is likely to be greatly increased, and it is not inconceivable that India may desire representation on any conference called to discuss

the problems of maternal and child health and to make recommendations for the sound development of the services.

In the *national* sphere, co-operation at the centre must be maintained with other central departments. Health whether in infancy, in the pre-school or school period, in industry or in old age is indivisible, and should logically come under a federal health department, but many problems will require joint action by two or more authorities if the right of the child to life, health, happiness and social security is to be safeguarded. The health of the pre-school child will require co-operation with the education department, the health of the nursing and expectant mother in industry with the labour department, the delinquent and mentally defective child with the home department, the nutrition of mothers, infants and young children with the agricultural department, the interpretation of vital statistics with the registrar's department, and in the field of publicity and propaganda much can be done through organizations like the Indian Red Cross Society and various women's organizations to achieve more concerted action, less diffusion of effort and energy, and consequently quicker results.

Co-operation with provincial, district and local agencies whether voluntary or official has already been outlined under the consultation service, and it only remains to say that without the generous co-operation of these agencies in placing at the disposal of the central department the results of their experiments and experiences, its function as a clearing house for all information regarding the life and health of women and children would be largely nullified.

Contacts with other *authorities* training doctors for the health services, pædiatrics and obstetrics, public health nurses, nursery school teachers, midwives and social workers, is another field for mutual co-operation, in order that the training may be linked up with the services required from the workers in the field. Various types of post-graduate courses will have to be planned either at teaching institutions, medical and health centres, or by sending experts to give advice and instruction to groups in their own locality. Advice in planning courses or in selecting and financing instructors may be required of a central department.

Many of the functions outlined above are undertaken by the Maternity and Child Welfare Bureau, Indian Red Cross Society, but in view of the constitution, status and resources of the Bureau, there are very definite limitations to what it can accomplish.

The nation's children are its most valuable assets and it is for consideration whether the time has not come for the nation to have a central department to ensure the sound development, the health happiness and security of its future citizens.

## Public Health Section

### PUBLIC HEALTH ORGANIZATION

#### III. PUBLIC HEALTH AND NUTRITION

By W. R. AYKROYD, M.D., Sc.D.

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'No preventive campaign against malaria, against tuberculosis or against leprosy, no maternity relief or child welfare activities are likely to achieve any great success unless those responsible recognize the vital importance of this factor of defective nutrition and from the very start give it their most serious attention. Abundant supplies of quinine and the multiplication of tuberculosis hospitals, sanatoria, leprosy colonies and maternity and child welfare centres are no doubt desirable, if not essential, but none of these go to the root of the matter. The first essentials for the prevention of disease are a higher standard of health, a better physique and a greater power of resistance to infection. These can only be attained if the food of the people is such as will give all the physiological and nutritional requirements of the human frame'.

The above passage appeared in the 1935 Report of the Public Health Commissioner with the Government of India. How far is it true?

India is a very unhealthy country. The expectation of life at birth was reckoned in 1931 as 26-27 years, a low figure which may be compared with 58.9 for England and Wales (1933), 61.9 for Sweden (1926-30) and 68 for New Zealand (1933). The nutrition worker often asks himself the question: what proportion of disease in India has its roots in malnutrition? Medical officers in hospitals will readily advance statements such as: 'half the patients wouldn't be here if they'd had enough of the right kind of food to eat', but such estimates scarcely constitute scientific evidence. Actually, it is quite impossible to make any satisfactory quantitative assessment of faulty and insufficient diet as a disease-producing factor in India. Some light may, however, be thrown on the question by the study of available morbidity and mortality statistics, and in this connection the trend of disease in famine times is of considerable interest.

#### *Mortality in infants and children*

The recorded infantile mortality rate for British India in 1939 was 155 per 1,000 live births. This means that a little less than a million and a half infants died before reaching the age of one year. Deaths in infants amounted to 23.6 per cent of total mortality. Of total infant deaths, 47.3 per cent took place during the

first month of life, and, of these neonatal deaths, 61.3 per cent occurred during the first week after birth. The percentage of still-births to live births is known to be abnormally high, though the recorded figures for still-births are very inaccurate. Respiratory diseases account for a large number of deaths in the later stages of infancy.

At present there is very little accurate information about the causes of infantile mortality in India and investigations of this problem are badly needed. In the Northern Circars, where adult beri-beri is prevalent, a very high mortality in breast-fed infants in the third and fourth months of life, almost certainly due to infantile beri-beri, has been recorded (Aykroyd and Krishnan, 1941<sup>1</sup>); this is an example of how a deficient maternal diet may profoundly influence infantile mortality. Who can doubt that in India generally the faulty feeding of mother and child is a factor of major importance in producing the high infantile mortality rate? In any ill-fed population group, whether human or animal, it is the newly-born and the very young that suffer most severely from the ill-effects of malnutrition. In Coonoor, as Sir Robert McCarrison has often pointed out, we have eliminated 'infantile mortality' from our colony of rats by providing an excellent diet based on whole wheat, milk, and fresh vegetables. Mother rats invariably rear successfully their litters of 6 to 12 young. In an ill-fed rat colony the vital statistics of suckling rats would be of a very different nature, resembling, in fact, much more closely the statistics of mortality among infants in India.

Mortality in India remains high throughout early childhood. 'About 49 per cent of the total mortality in any given year is among those below 10 years of age, while the corresponding figure for England is only 12 per cent. During the first year of life India's proportionate mortality is about three and a half times that of England, at the next period (1 to 5) it is about five times greater, and between five and ten years it is more than three times as high' (Public Health Commissioner's Report for 1936). In 1939 total deaths under 10 years amounted to 2.9 millions, or 47 per cent of all deaths. It will be recalled that in most Western countries early childhood is one of the healthiest periods of life.

The causes of the high mortality in India during early childhood have not been investigated. In this connection the observations of de Haas (1940) in Java are significant. Haas finds that in Batavia about 22 per cent of total mortality occurs in what he calls the 'pre-school' group—children aged 1 to 4—whereas in Holland the percentage in 1939 was 3.1. The actual death rate within this group in Batavia was 76



per thousand. The same worker (1939) strongly emphasizes the importance of malnutrition as a factor in producing this very high mortality :—

'Tropical nutrition in general and the food of pre-school children in particular show deficiencies for the poorer classes among which shortage of calories, animal protein and vitamin A are the most important\*. Dairy produce practically does not appear in the native diet of Batavia.... After breast feeding has ceased, the children, then about one year old, are still too small to select food for themselves. It is the children of pre-school age, therefore, who suffer most from the insufficient tropical nutrition. Their menu consists mostly of rice and a few vegetables, and so it is not surprising that such serious deficiency diseases as xerophthalmia and nutritional oedema are found most among children of pre-school age and that dystrophic development is most conspicuous among those from a half to three years old'.

Haas goes on to say that among children of pre-school age, pneumonia and bacillary dysentery take the first place as causes of death. He remarks that 'it appears likely that the frequency and fatality rate of bronchopneumonia and the general state of nutrition of the children are in closer interrelation than is the case in the majority of other infectious diseases'. His general experience in the Children's Department of the Medical College in Batavia leads him to believe that malnutrition is a major factor in causing disease and death in young children. 'Since the state of nutrition is nearly always defective, too much significance cannot be given to the causes of death in children of pre-school age'.

There is no reason to suppose that the state of nutrition of poor children in most parts of India is in any way better than that of children in Batavia, and the conclusions of Haas can probably be applied to India. A visit to a children's ward in an Indian hospital will provide confirmatory evidence, for such wards are always thronged with cases of nutritional disease and of disease indirectly due to malnutrition.

#### *Maternal mortality*

The female death rate during the reproductive period (15 to 45) is higher than the male, and the excess is largely due to mortality from child-bearing. Estimates of maternal mortality in various parts of India vary from 16 to 24 per 1,000 live births—a very high rate. In an enquiry carried out by Neal Edwards (1940) in Calcutta, it was found that 23.3 per cent of maternal deaths were due to anæmia. Co-existent anæmia probably plays a part in the high death rate from puerperal sepsis, the principal recorded cause of maternal mortality.

Here again, while a quantitative assessment is impossible, it is reasonable to suppose that diet

deficiency is responsible for much of the illness among pregnant women in India. The relation between diet and the anæmias of pregnancy requires further elucidation, but it can be assumed that faulty diet is one factor in their causation. All nutrition workers know that the pregnant organism is highly sensitive to the ill-effects of diet deficiency. It is the invariable practice, in drawing up dietary standards, to set the requirements of pregnant and lactating women for vitamins and mineral salts at a higher figure than those of non-pregnant women.

#### *Nutrition and various common diseases*

A full discussion of the relation between nutrition and the common diseases of India would make this article too long. We can probably at once dismiss the possibility of any association between malnutrition and cholera, small-pox and plague, diseases which occupy the major part of the attention of public health departments. It is to be observed that they are to-day, numerically speaking, not important causes of death. It has often been suggested that deficient diet is a predisposing cause of leprosy, but there is really very little evidence in support of this hypothesis. Further investigation of this problem is required. The greatest single cause of deaths in the mortality returns is 'fevers', a heterogenous group in which malaria stands pre-eminent. It has been estimated that about a hundred million persons suffer annually from malaria in India and that the annual number of deaths exceeds 1.5 millions. Many malariologists have drawn attention to an association between malaria and economic stress, and the invariable accompaniment of the latter, malnutrition. This question has recently been discussed by Passmore and Sommerville (1940), who found that the course of primary attacks of experimental malaria in monkeys was unaffected by differences in state of nutrition. There does not appear to be any conclusive evidence that nutrition influences the epidemiology of malaria or the susceptibility to, or severity of, the disease in individual cases. There is, however, a close relation of the opposite kind between malaria and malnutrition. Malaria is a direct cause of malnutrition because its languid victims cannot cultivate their land properly and improve their lot. Vigorous anti-malarial measures will improve food supply and the national diet.

The voluminous reports of famine commissions published during the second half of the last century contain much material of interest about the effect of famine on the birth-rate, the death-rate, and the influence of food scarcity and famine on the incidence of various diseases, which even to-day would repay further study. In more recent times, Lieut.-Colonel Nicol (1941), Director of Public Health in the Punjab, has published an interesting analysis of mortality and morbidity in the Hissar famine of 1939-40. The total number of deaths in Hissar in the worst

\* The author would place more emphasis on deficiency of vitamins of the B. group.

famine year (1939) was 37,767, as compared with 20,910 in 1937. The rise in the death rate was greatest in the age groups 'under 10 years' and '60 years and upwards'—i.e., among the very young and the very old. Of the 37,767 deaths in 1939, 21,160 occurred in children under 10. There was no rise in the incidence of malaria, and small-pox and cholera were kept under control. But there was a striking increase in the number of cases of almost all other diseases during the period when food supply was deficient in quantity and also in quality. The following figures, showing the number of cases of various conditions treated in hospitals and dispensaries in Hissar, in 1937 and 1939 respectively, are taken from Nicol's report:—

|   | Number of cases |        |
|---|-----------------|--------|
|   | 1937            | 1939   |
| Respiratory diseases (excluding pneumonia and pulmonary tuberculosis) .. .. | 25,178          | 44,117 |
| Pneumonia .. ..   | 1,409           | 1,942  |
| Tuberculosis of the lungs .. ..   | 696             | 973    |
| Dysentery and diarrhoea .. ..   | 10,268          | 19,907 |
| Enteric fever .. ..   | 282             | 539    |
| Trachoma .. ..  | 21,031          | 26,550 |
| Pyrexia of uncertain origin and other diseases due to infection             | 2,925           | 5,216  |

Some of the increase can no doubt be attributed to the disorganization of living conditions inevitable in famine times, and allowances must be made for the inaccuracy of hospital and out-patient department statistics. The figures are nevertheless striking, and illustrate how the resistance of a population to disease in general is conditioned by the dietary factor. A large percentage of the population of India lives on a diet which is defective in quality and often in quantity. It is not unreasonable to suppose that the incidence of diseases which become more prevalent in times of food-scarcity is influenced by diet in normal times.

Much has been written about the association between malnutrition and tuberculosis, a disease of growing public health importance in India. It appears to be generally accepted that a poor diet lowers the resistance of the body to the tubercle bacillus. Special attention may be drawn to one group of diseases—those falling into the category 'dysentery and diarrhoea' in the health returns. As a result of experiments carried out in Coonoor, McCarrison (1921) reached the conclusion that 'the health of the gastro-intestinal tract is dependent on an adequate provision of accessory food factors' and observed that 'experiments with animals have led us to expect that acute intestinal disorders will be among the commonest of the consequences of deficient and ill-balanced food'. More recently Rao (1942) has produced in monkeys a chronic diarrhoea accompanied by atrophic changes in the small intestine by feeding with ill-balanced rice diets. It is perhaps significant that the death rate from dysentery and diarrhoea in the Punjab is usually from one-fourth to one-sixth that of Orissa, the Central

Provinces and Madras. The Punjab is a wheat-eating province with a relatively high consumption of milk, while in the latter provinces rice is the principal or an important staple and consumption of milk is low.

#### *Food deficiency diseases*

Deficiency diseases—i.e., diseases directly due to insufficiency of some necessary constituent in the diet and capable of being prevented or cured by supplying that constituent—are in themselves a problem of public health importance. In the Northern Circars beri-beri in adults is a common disease, leading to much suffering and disability but not often to death. Beri-beri in infants, as has already been pointed out, is probably the cause of many infant deaths in this area. Keratomalacia is probably the commonest cause of permanent blindness in South India; it is also prevalent in other parts of the country. Osteomalacia and rickets present a formidable public health problem in certain parts of northern India. One of the commonest of deficiency states is a syndrome including stomatitis, dermatitis in the genital regions and sometimes superficial keratitis, which is associated with lack of the B<sub>2</sub> group of vitamins, and in particular with riboflavin deficiency. Goitre is another nutritional disease, highly prevalent in certain Himalayan and sub-Himalayan areas. Severe scurvy is uncommon, except in famine times. Further clinical research will probably reveal other deficiency diseases, at present unrecognized. Diabetes—the scourge of the middle classes in India—can scarcely be included under this head, though its cause is presumably some long-continued error in diet. It has so far received little attention from nutrition research workers in India.

Epidemic dropsy is a nutritional disease of considerable importance in Bengal. Recent work seems to have established that it is due to a toxic factor in the diet rather than to diet deficiency, but it can none the less be described as a nutritional disease. The most satisfactory proof that it is caused by contamination of mustard oil by *Argemone mexicana* would be its elimination by public health measures based on this hypothesis.

#### *Public Health Nutrition Work*

There is thus no lack of evidence that nutrition is a factor of basic importance in public health. Nutrition work is an essential part of public health activity, and any organizations concerned with public health in general which do not include nutrition work in their programmes are neglecting their manifest duty. But while methods for dealing with infectious diseases, etc., have been evolved as the result of experience, methods of tackling the problems of nutrition are less clearly defined. At the outset the public health worker comes up against the difficulty that the basic cause of malnutrition in India and elsewhere is the economic factor over which he has little control.

But even in the existing economic circumstances, progress can be made in raising dietary standards if the best use is made of available resources. The first essential is the education of those who in turn can educate the people. This means that greater emphasis must be laid on nutrition in the training of doctors and public health workers of all grades. It means that school teachers should be taught simple facts about food and diet, and impart them to their pupils. It means the education of the professional and administrative classes generally, including workers in agricultural, animal husbandry, and development departments.

Within the strictly public health sphere, it is desirable that all public health departments of any size should include a specialist in nutrition who can undertake, among other duties, educational and propaganda work. In a small public health department, it may not be feasible to employ a full-time 'nutrition officer'; if this is so, some member of the department can combine nutrition work with other activities. In India, full-time nutrition officers, trained in Coonoor, have been employed in public health departments in Bengal, the Punjab, Bihar, the Central Provinces, Baroda and Hyderabad. A nutrition officer was also employed in Burma. Workers in other health departments have also taken the course and have carried out some educational work.

Other aspects of public health nutrition work may be briefly mentioned. The League of Nations Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene (1937) outlined the work of public health nutrition specialists as follows: 'They can carry out field investigations, engage in propaganda work, organize school-feeding schemes, advise regarding the dietary aspects of maternity and child-welfare work, regulate diet in government and charitable institutions, such as schools, mental homes and leper asylums and so on, and in general assist in the practical application of nutritional science'.

School medical inspection, particularly if it includes the instruction of parents whose children's state of nutrition requires attention, is an important branch of public health nutrition work. So are school-feeding schemes. Maternity and infant welfare work is primarily nutritional in character, or, if it is not, it should be. In India there is valuable and essential public health work in the sphere of nutrition to be done in famine areas. A full discussion of the different branches of public health nutrition work will be found in 'Nutrition and Public Health' by Burnet and Aykroyd (1935) and in various subsequent League of Nations publications.

Half the mortality recorded in India occurs in children under 10 years. Malnutrition is one of the chief causes of the rapid exit of young human beings from the world so soon after their

(Concluded at foot of next column)

## PREVENTIVE PÆDIATRICS :

### AN ACCOUNT OF HEALTH WORK IN TRENGGANU, MALAYA

By J. W. SCHARFF, M.D., D.P.H.  
and

CICELY D. WILLIAMS, D.M., M.R.C.P., D.T.M. & H.

With a preface by Hon. G. A. DE C. DE MOUBRAY  
*British Adviser, Trengganu*

Condensed by JEAN BIGGER

[The full report of which this paper is a condensation would in ordinary times have been printed by the Government of Malaya. Because it contains much of interest to workers in preventive medicine and to those interested in rural health problems, we take this opportunity to print it here. The problems with which it deals are comparable to those of workers in India. The methods and achievements of the authors may well prove an inspiration to us.]

## PREFACE

By G. A. DE C. DE MOUBRAY

My own regeneration in matters medical started with reading Dr. Victor Heiser's 'A

(Continued from previous column)

arrival in it. It cannot be said that public health has disposed its forces so that this, the most dangerous section of the front, is the most strongly defended. In fact, most of it is defended weakly or not at all; for in India, as in most other countries, the pre-school child is almost completely neglected in the organization of public health.

With certain qualifications, the statement from the Public Health Commissioner's Report with which this article began may be endorsed. The vital statistics of India, inaccurate though they may be, provide clear indications for the future orientation of public health work. The improvement of diet is of essential importance if the goal of a healthy nation is to be attained.

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Doctor's Odyssey'. Dr. Heiser, after being Director of Health in the Philippines, was selected by Rockefeller to organize the health campaign in the Far East. It is in the circumstances not surprising that he combined with a 'health' approach to medical problems a hard-headed emphasis on finance. The lessons which I, together with numbers of others, have learnt from his book have been that medical policies should be judged by results, not merely clinical results, but statistical results of mortality and morbidity. Moreover, the relation between expenditure and statistical results should be kept well in the foreground. For a given expenditure, one should set out to obtain the greatest statistical results in the way of reduction of morbidity.

Dr. Heiser points out that judging by these standards the hospital approach to medical problems fails if divorced from the preventive approach. He quoted as an example the tremendous expenditure in Japan in organizing an extremely modern hospital system. The Japanese Government eventually realized that this vast expenditure had in no way reduced the death rate or the sickness rate.

Dr. Heiser emphasizes the necessity of starting by an investigation of the health problem in each country and in each part of a country, and the necessity for concentrating on the diseases causing the greatest sickness and mortality.

On my arrival in Trengganu nearly two years ago, I was disappointed to find that in the 20 years, since Trengganu had come under British Advice, expenditure and effort had been concentrated almost entirely on the clinical approach to the medical problem. A development of preventive work seemed however almost impossible owing to the financial situation.

In September 1940 I met Dr. J. W. Scharff and discussed the problem with him. It interested him to such an extent that he offered to come to Trengganu on six months' secondment. I accepted his offer with alacrity. Shortly after his arrival here he suggested that Dr. C. D. Williams should be asked to visit, so that he could have her assistance in checking his conclusions and proposals in the matter of infant welfare. She subsequently acted for Dr. A. L. Shield, medical officer, Trengganu, when the latter went on long leave.

Their methods were an inspiration to me. They obviously made use of (and re-examined) all the vital statistics available and all the information accumulated in the hospitals. What was new in their technique was, instead of the laborious accumulation of data in the field and writing of a report on which action might, or might not, be taken, the rapid evaluation of the situation followed by the equally rapid formulation of policies and their immediate execution, if only on an experimental scale. I accompanied them on a few of their expeditions. There was little difficulty in assembling all the children and most of the adults in the kampongs in which we

spent any time. A rapid examination of the children was sufficient to tell us whether in that locality malaria was a problem which had to be dealt with or whether it could be disregarded for more urgent problems.

One could roughly estimate the importance of yaws, malnutrition, worms, and other diseases as causes of morbidity, and therefore, in the long run, of mortality. Whole tracts of country were rapidly compared in this fashion. Special attention was devoted to areas with a high general death rate or high infantile mortality rate. I was much impressed with the rapid formulation of policies and the almost more rapid putting of them into effect. In a medical and scientific enthusiast such as was Dr. Scharff, I was astonished to find such a keen appreciation of the financial aspect of his schemes. He had costs per head of population at his finger tips. Coming from the heavily populated and comparatively rich Colony of the Straits Settlements he was fully aware that different methods would probably have to be used in Trengganu. As an example of this, engineering works and large-scale oiling were ruled out in the fight against malaria. Trengganu must depend on naturalistic methods.

#### *Welfare organization*

The financial nexus takes an important place in the philosophy of welfare work. The thesis is, I think, generally recognized that a given amount of well-directed effort, and therefore a given expenditure, will produce the greatest long-term results if spent on the unborn child and progressively lesser results on infants and older children. In spite of the fact that expenditure of effort and money on children of the youngest ages is the most remunerative from the point of view of building up an A-1 population, the graph of return in terms of health plotted against increasing ages of children flattens out only gradually. There is no hard and fast line. Moreover the health of the infant cannot be maintained without attention to that of the rest of the family. Yaws, worms and malaria afford excellent examples. It is no use devoting attention to infants if other members of a household are infected with yaws and worms. In those areas in which infant mortality is due to malaria, one can obviously do next to nothing without dealing with the malaria problem in that locality. This principle, developed in the monograph, is paralleled by the American theory that infant welfare must merge into family welfare and that again into community welfare.

#### *Relation between hospital and welfare work*

There would appear to be a tendency to consider clinical and preventive work as rivals. In the Anglo-Saxon world another tendency has been rapidly increasing, that of considering that

there should be a balance between them. There should even be more than a balance; a correlation. This correlation has been realized from early days as in the Rockefeller Foundation attack on ancylostomiasis. But the convincing argument in this monograph extending this principle of functional correlation to welfare work appears to me new.

From a philosophical standpoint the balance between clinical and preventive methods is a balance between methods designed to have short-term and long-term results. It is a great philosophical advance to realize that the relation goes even deeper, that clinical and preventive methods should be articulated together as though they were parts of the same living organism.

There are three medical arms: hospital, preventive work, and education. The hospital is the short-term approach to health problems. Preventive work is the medium-term approach and education the long-term approach.

### Results

In the matter of nutrition, the campaign for getting the population to eat under-milled rice has had such success that the Kuala Trengganu mill has for many months been producing only under-milled rice. The demand has been greater than the supply.

Antimalarial work has had clear statistical results in the main experimental area. The peasants have not only realized their comparative freedom from malaria, but, much to my surprise, and no doubt owing to the health inspector who had lived among them, have realized that it was due to the herbage-packing of seepages, and to the consequent diminution in anopheline mosquitoes. This has been an educational as well as a preventive victory.

At the other end of the social scale the anti-malarial work has been much appreciated by members of the Malay Government. A point of interest is that this has perhaps been due not so much to the success of the work in Trengganu as to rumours of Dr. Scharff's successes in Singapore seeping up through various channels. It shows that successful preventive work can gradually spread an aura of adaptability to such work.

I accept Dr. Williams' statement that it is still too early to assess the success of the welfare work on statistical results. The great success in this field has been that the Malay women have shown their belief in it by visiting welfare centres in such numbers that the demand has exceeded the capacity of the present organization.

The educated Malays have been won over to a long-term policy of working through the education of girls. The Malay Superintendent of Education is enthusiastic about the English, domestic science, and welfare classes to be started in the girls schools.

## SECTION I

### CONDITIONS IN TRENGGANU

By CICELY D. WILLIAMS

#### 1. Introduction

THIS is an attempt to describe the health programme lately undertaken in Trengganu.

It has always appeared to me that there could with benefit be more co-operation between the preventive and curative sides of medicine, between welfare centres and hospitals. As a welfare worker I have been reprimanded for attempting to cure my patients, and as a pædiatrician I have been discouraged from having anything to do with preventive medicine. In Trengganu there has been a precious opportunity of establishing work on sound lines of preventive pædiatrics.

The objectives were:

- (a) to discover what actually were the conditions and diseases that led to the large infant mortality, the prevalent ill-health, backwardness and lack of initiative in the population;
- (b) to apply methods of dealing with these conditions that would be adapted to their needs;
- (c) to do this at minimum expense.

This report covers a large number of activities. They are every one of them essential to preventive pædiatrics.

#### 2. Conditions in Trengganu

(a) *General*.—Trengganu is an unfederated State on the east coast of Malaya, covering 5,050 square miles and with 160 miles of coast line. Only about one-seventh of the land is in occupation, the mountainous inland is covered in deep jungle. There are few roads and no railways. The population, estimated at about 200,000, is 90 per cent Malay. They are poor. The land is not very fertile. Paddy and fruit and vegetables are grown, but the foothills in many places run close to the sea, making these districts malarious. A great deal of land which could be used for cultivation and for grazing is lying idle. Fishing is a very important industry. Rubber and copra are produced in small quantities and there are some tin and iron mines, but the mine labourers are nearly all Indian and Chinese. Weaving and boat building and the manufacture of goods in 'white brass' are beautiful and highly skilled, though poorly paid industries.

The State is governed by the Sultan and his Council with the help of a British Adviser. There are about 20 Europeans employed in the Government service.

(b) *Finance*.—The total revenue of the State in 1940 was \$3,305,006 including \$171,189.68 war taxation and a windfall of \$149,000 from the Currency Surplus Fund. (One dollar Straits equals two shillings and four pence sterling.) Medical expenditure rose from \$69,601 in 1935 to \$141,324 in 1940, the percentage of medical

to total expenditure being respectively 3.4 per cent and 5.4 per cent.

(c) *Health*.—It was most particularly to the Malays, who are at the same time the most numerous, the most unhealthy and the least health-conscious members of the population that we had to address our attentions. Dirt and ignorance, poverty and prejudices produce their most unnecessarily large mortality and morbidity. The people mostly live in scattered rambling kampongs where sanitation there is none. Every bit of the ground is infected with excreta which is of great benefit to the coconut trees. To bathe is to stand beside a well and slosh water over the sarong-invested body. The children have skins that are constantly subject to trauma and infections. The consequence is yaws and ulcers externally and worms and dysenteries internally. People are nearly all indolent and conservative, largely as a result of their diseases.

(d) *Family life*.—Mohammedan beliefs are modified by pre-Islamic tradition. Each man is allowed four wives at once, but in practice few have more than one or two, however rapidly they may succeed each other. Most women are married more than once. Eighteen times was the maximum that was admitted to, but three or four times was usual. The more well-to-do men may be forced into marriage by their female relatives sometimes as early as 15. The girls usually marry at 14 to 16. The women have a good deal of indirect authority or nuisance value in affairs. A woman cannot divorce her husband but she can become so irritating that she can ensure her freedom. The semi-purdah lives of the women have a serious effect on their development, mentally, emotionally and physically. There is little in the way of amusements. Happily football for the men is becoming very popular in the kampongs, but as there is no drama or music or dancing, there is little entertainment for the women except the 'makam besar' (feasts) for weddings, funerals and circumcisions and amorous adventure. The women know that as soon as they are old and ugly they may be neglected, and they naturally make the most of youth and beauty while these last. The plague of the adopted child, the 'anak angkat', is a serious one. The physical and psychological evils of these unnecessary and often mercenary transfers are too well known to need emphasis. The instability of family life has an adverse effect on the health of the population both mentally and physically, on the care of the children and on the general prosperity.

(e) *Education*.—There are 40 schools in the State with a total of 4,281 pupils. This represents 20 per cent of the estimated number of children of school age.

(f) *Vital statistics*.—Figures are at present of necessity, unreliable. There has been no census since 1931. Only 5 per cent of deaths are reported by qualified practitioners, all the others

being done by police and by penghulus (village headmen). There is a list of 80 causes of death from which they may select. In practice it is found that all adults die from 'deman panas' (hot fever) up to the age of 35; after that the cause of death is 'sakit tua' (senility). Among infants it is about fifty fifty between 'deman panas and sawan or sewan tenges' (convulsions and crying convulsions). These deaths from 'deman panas' were just as freely entered in the non-malarious as in the malarious districts. On investigating infant deaths and getting fuller histories (post mortems were difficult to obtain, but one was generally able to view the dead body), it was found that both fever and convulsions were rare. The deaths were in fact due to beri-beri, prematurity, congenital debility and emphatically most of all due to dietetic indiscretion. It is possible that more complete registration would reduce the infant mortality rate. There is a great deal more celebration over a death than over a birth. While the latter may go unreported, the former is not likely to do so. It is likely that the large reduction in the I.M.R. for Trengganu in 1940 was partly due to improved registration which followed on some prosecutions for failing to report births.

The birth rate in the State has varied in the last four years between 34 and 41, and the death rate between 22 and 25. Maternal mortality is estimated as 5 per thousand births. All these figures are probably only approximate.

(g) *Nutrition*.—Rice is the staple diet and about one-third of the total consumption is grown within the State. Most of the paddy is cultivated by primitive methods, including shifting cultivation, which is tending to silt up the rivers. For a variety of reasons, the overall average yield of paddy per acre is particularly low in this State. In the towns and among the fisher people who have little or no paddy land the rice eaten is 'Barat No. 2', a second quality Siam rice, rather broken but not highly polished. Yet beri-beri is a very frequent complaint, particularly in the towns. Paddy can be pounded on the 'lesong' until all the pericarp is gone and much of the home-pounded grain is robbed like this of its nutritional value. But it is not difficult to persuade these people that unpolished rice is a better food. They bought and used it readily when advised to do so. A great deal of fish is eaten, both dried and fresh. The oils that it may contain are largely driven off by drying and by roasting over the coals. In any case most fish is a poor source of vitamin A, and this makes it rather worse. According to the recent work of Professor Rosedale and his co-workers, many of the larger varieties of shark caught in Malayan waters provide a liver oil which has a very high value of vitamin A, but these large fish are seldom seen in the local markets. Meat is eaten only very occasionally. The rest of the diet consists mainly of coconut oil and coconut-sugar, cassava, yams and cocoyams, sweet potatoes, beans and



a large variety of green leaves used for spinach, pumpkins, cucumbers, egg plant, onions, tomatoes, generally taken with a great deal of chili and curry stuff. Bananas, pineapples, oranges and water melon are varied with other and stranger fruits, such as durian. Cows, buffaloes and chickens are kept and in the coastal areas a few sheep and goats as well. Milking is practised in a few kampongs, and rather spasmodically. Buffalo milk is made into clarified butter for cooking curry. Curdled, in bamboo joints, it is also sold for a few cents as an indigenous variety of curds and whey or yoghurt. (This can easily be made into an excellent cottage cheese.) Milk is drunk either fresh or heated, mostly by the men. With a little education, it should not be difficult to introduce it more lavishly into the diets of children and pregnant and nursing women. In the rest of Malaya there seems to be an antipathy among Malays to the consumption of fresh milk from a cow as distinct from milk from a tin. This is probably due to the almost universal migration of the well-to-do Malays into the towns, the traditional sophistication of the food of town dwellers and fresh milk being looked upon rather as an indelicacy.

The actual fishermen and their families may consume an adequate amount of protein during the fishing season. But in general the diet is deficient in proteins and animal fats. This deficiency becomes more marked inland, and is very pronounced in the upper regions of the rivers. For young children the diet is also too coarse and irritating.

### 3. Diseases

(a) *Methods of investigation.*—To determine what were the diseases of greatest importance, the hospital statistics were of little value. Of the population of the State 90 per cent is Malay, but of the hospital admissions, less than 30 per cent are Malays. Children under 5 years provide half of the deaths, but only 5 per cent of the hospital series. It was necessary, therefore, to explore the kampongs and then get admission into the huts. We went to the houses as soon as a death was reported, and, by getting data, often wildly contradictory, from the assembled guests and relatives, it was possible to ascertain some of the important facts that are concerned with mortality and morbidity, particularly those relating to the children and infants.

(b) *Malnutrition* produces ill-health in various ways. These may be classified as food that is improper in quantity, improper in constituents, and food that is contaminated by harmful substances. In the first category we get a number of people who are underfed and a few who are overfed.

Improper constituents of food may be physical or biochemical. Among the former we have the quantities or coarse, bulky carbohydrates and substances that are irritating, such as pepper and dried fish which are given to young children

and which may produce distension and severe intestinal indigestion. Biochemically the food as a whole is poor in protein and animal fat. It is also conspicuously lacking in vitamins A and B. If polished rice is the main diet, then beri-beri often occurs, sometimes in the acute cardiac and sometimes in its more chronic forms. The skin conditions that are generally associated with lack of vitamin A are not uncommon; no statistics of the number of blind people are available, but there are many. Rickets occurs occasionally. As in Singapore, it is not uncommon among babies brought up in dark houses away from the sunlight and fed on sweetened condensed milk. The low fat and high carbohydrate content of this milk makes babies fed on it peculiarly liable to develop keratomalacia and rickets unless they are given cod-liver oil or some other source of vitamins A and D. Both Chinese and Malaya, in their misguided admiration for a pale skin, are wont to keep babies far too much indoors even when the exigencies of slum houses do not force them to live in the dark, ill-ventilated cubicles. Rickets is not seen in older children, or with gross bony deformities. Either the baby dies young from one of the catarrhal conditions (of chest, stomach or intestines) to which rickety children are particularly subject, or else, on reaching the toddling stage, they go into the sun enough to arrest the disease.

Two cases of pellagra were seen, both in Chinese who also had beri-beri. Nutritional dermatitis of the various types ('mosaic' and 'pellagroid') was perhaps rather less common than appeared to be the case among the poorer classes in Singapore.

Food is generally speaking kept, prepared and eaten by insanitary methods. It is often infected, with the result that worms, diarrhoea and dysenteries are common.

Artificial feeding of infants is almost universal among the sophisticated and the high born. Even among the kampong people it is not uncommon.

Even people in a good position and 'well educated' are ignorant of what and how to eat. Emaciation, asthenia, apathy and chronic malaise are the result. Malnutrition, lack of initiative and lack of discipline lead to such conditions as 'latah' and 'amok'. These are not specific diseases, but merely the evolution of quite common attitudes of mind.

(c) *Worms.*—The population is almost universally infected with worms, and this is some indication of the sanitary standards. The presence of intestinal parasites not only does active harm, but also does so much to interfere with the absorption of food that it has a very sinister influence on nutrition. This applies especially to babies and to young children who have not yet acquired any immunity towards the parasites. The chief trouble is the round worm. It has been estimated that about 90 per cent of the population has been infected. Hookworm is

present in some 30 per cent of people; *Trichocephalus dispar* is practically universal and in some cases seems to do damage. Strongyloides and clonorchis are both very rare.

Round worm infection generally starts much earlier than any other. Babies may be infected any time after birth, presumably from the dirty fingers of the mother or other attendants as they push the 'tepong' and 'sugi' down the infant throats. As early as three months babies have been known to pass ascaris eggs.

It is common all over the world to find ascariasis underestimated as a cause of sickness and death. It is high time that this complacent attitude should be changed.

(d) *Yaws*.—According to all accounts, yaws in the past was very much more common than it is now. As in other countries, it seems that yaws is tending to die out in the towns where children are inclined to wear more in the way of clothes, and spend less time 'carousing in the dirt', and are therefore less certain of infection. However, in Kuala Trengganu hospital it will be found that the majority of the patients have sought admission for some sort of ulcers, and that the cause of the great majority of the severe and intractable ulcers is yaws. On going through the kampongs it will be found that there are ghastly cases of mutilation and crippling that are due to yaws and that are kept hidden away.

It is remarkable that the late results of yaws, chronic ulceration, rheumatic pains, gangosa, dermatitis, bursitis, epiphysitis, sinovitis, leucoderma, etc., are not recognized by the people themselves as having any relation to yaws. Textbooks contain the misleading statement that one attack protects. It would be more correct to say that one attack may never finish unless rigorous treatment is adopted. The patient is always liable to suffer from some form of recrudescence right into old age, 40, 50, 60 years after the primary attack.

It was found that the medical staff sometimes missed diagnosis of the sequelæ of yaws, and even of the earlier stages. In 1940 the Kahn test was done on 122 patients of which 18 per cent were positive. There are now nearly 100 examinations being made monthly of which nearly 50 per cent are positive. This is possibly in some measure due to increased yaws consciousness.

Among yaws-infected members of the population are found numbers of cases of sterility, both relative and absolute, of still-births and of neonatal and of infant deaths. There are also cases of anæmia, and ulcerations that only improve on treatment classed as anti-specific. As far as I know cases of congenital yaws have not yet been proved, but it is quite certain that untreated yaws in the mother has an adverse effect on the progeny. Yaws and syphilis appear to be very much the same disease. So many of their manifestations are indistinguishable. The former is non-venereal.

and derma-osteotropic, while the latter is generally venereal and genito-neurotropic.

Treatment has been available for many years. A few years ago it was decided to overcome the objection to treatment by offering stovarsol pills instead of injections. These pills have a great reputation for their aphrodisiac effect. They sell for 20 cents each in the shops and it was thought that this form of treatment would be popular. But whether the wrong people take the pills or whether they are not taken at all, yaws still remains one of the major health problems.

We are now trying to re-establish treatment by injection, and in recent months the numbers of patients willing to receive this form of treatment has showed a satisfactory increase.

Even if few patients attend sufficiently regularly to receive a complete course or a complete cure, still one or two injections will dry up the lesions enough to make the disease less infective and in time to reduce its prevalence. Preparations of organic arsenic are expensive and are becoming increasingly difficult to obtain, and so bismuth salicylate in oil for intramuscular use is being prepared in the dispensary. There are very few complaints of any after-effects or of pain, the results on the yaws are very satisfactory, and it has the advantage of being extremely cheap.

(e) *Malaria*.—Malaria is a very serious problem in some areas. But in the State as a whole it only accounted for a small proportion of the mortality and morbidity. The average spleen rate in the schools is under 4 per cent. Of the 3,503 deaths in 1940 that are ascribed to 'malaria and unspecified fever', only 76 could actually be certified to be malaria. In one of the dispensaries in one month 176 cases were reported as malaria, but of nine blood films examined only one contained parasites.

(f) *Other diseases*.—Anæmia is very prevalent, owing mostly to malnutrition, worms and the indoor habits of many of the people. At a guess I should say that the average hæmoglobin of the State is less than 50 per cent.

Respiratory diseases are fairly common, but among hospital patients there are very few pneumonias among Malays and Chinese compared with the large numbers among Tamils. Chronic bronchitis and asthma, probably associated very often with worms, are very common among Malays. Tuberculosis is a very serious scourge, phthisis, especially in young adults, being the variety most usually met with. Adolescent girls and young women scarcely ever go outside the houses and their resistance is therefore extremely low. It is probable that when Malays start bringing their children for hospital treatment it will be found that tuberculosis is responsible for a great deal of trouble. It is exceedingly difficult to get even the educated Malays to understand the dangers from tuberculosis, and how they can be

avoided, and to alter their way of life one whit in order to avoid them.

Malay children, if they are breast-fed, generally have fairly good teeth, but in older people pyorrhœa and dental sepsis are very pronounced.

Venereal disease is fairly common but it is impossible to estimate either extent or severity.

#### 4. The Medical Service

*Kuala Trengganu.*—Medical officer, assistant medical officer and dental surgeon. Hospital with 160 beds and dispensary. Town dispensary, travelling dresser and midwife. (Senior health nurse and five welfare centres.)

*Dungun.*—Assistant medical officer. Hospital with 20 beds and dispensary. Travelling dresser and midwife.

*Kemaman.*—Assistant medical officer. Hospital with 56 beds and dispensary. Travelling dresser and midwife.

*Besut.*—Dresser, travelling dresser and midwife.

*Kuala Brang.*—Dresser and travelling dresser.

*Kampong Buloh.*—Dresser.

*Kemasik.*—Dresser.

One or two mines and estates have their own dressers and doctors.

The dressers are most of them trained in the State of Trengganu. Naturally the facilities for a conventional type of training are not very good, but in spite of that much has been done to make them both keen and efficient. One handicap is that no trained nurse or sister has ever been regularly stationed here.

Medical reports have always included a section on 'Maternity and Child Welfare', but in the absence of any specific work on this subject, in practice it has meant that infants and children attending for treatment of any description have been classified under this heading.

On examining the medical reports it will be found that :

(1) Only a small proportion of Malays seek admission to the hospitals, and they form two categories, firstly accidents and police cases, and secondly chronic ulcers.

(2) A very small proportion of women and children come for in- or for out-patient treatment. Yet infancy and childhood are the ages most in need of protection and care of health.

(3) Chinese women form a very small proportion of the total female population, but it is chiefly they who patronize the government maternity service.

It is obvious that the health of this State can only be improved by bringing health education to those who need it most, that is, the Malays, and most particularly to the Malay women and children.

It is likewise obvious that conditions cannot be remedied on any large scale by the methods

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## COMPOSTING : A PUBLIC HEALTH PROBLEM

By GAURCHANDRA GHOSH, B.E., M.R.S.A.I.

*Definition.*—Composting may be defined as preparation of manures by the fermentation of bulky organic refuse materials, of either plant or animal origin, brought about by a complex flora of living organisms.

*History.*—From ancient times the Chinese have led the way in the methods of utilization of both habitational wastes and farmyard refuse. All the dry portions of refuse they generally add to the compost heap, while liquid refuse including night-soil is directly put on the land. Although the application of crude night-soil to the land may be undesirable from a sanitary point of view, rice is specially benefited by it, and the demand for this is so great that the city of Shanghai in 1908 entered into a contract with a Chinese allowing him, in return for a payment of 31,000 gold dollars, the privilege of entering the houses and removing the night-soil.

Hutchinson and Richards in 1921 first enunciated the scientific principles of composting straw and other organic matter into synthetic farmyard manure. Since then various methods have been introduced to suit varying local conditions. Richards introduced his 'Adco' process in 1921. The Indore process of Howard and Wad (1931) and Jackson and Wad (1934), the 'activated compost' process of Fowler (1934), the Bangalore hot fermentation process based on the Edelmist process devised by Krantz and Beccari process, are some of the more important methods of composting.

Some of the recent experiments have been directed towards composting of sewage sludge with town refuse (Maidenhead and Leatherhead in England).

*Problem of Composting.*—Composting is becoming of interest to both public health and agricultural administrations in proportion to the degree that satisfactory methods have been evolved, which depend upon local customs and meteorological conditions. However, China is the only instance (Winfield experiments) of scientific investigation of the microbiological health aspects of composting which in the other instances has been studied from an agricultural standpoint.

(Continued from previous column)

associated with purely institutional medicine. It is only by reforming the outlook on health and domestic and nutritional habits that improvement can be effected. It is superlatively obvious that a well-aimed scheme for maternity and child welfare would be the method *par excellence* for introducing these improvements.

[Section II on the scheme for health work by both the authors will be published in our next issue.]

The efficiency of any method of composting has to be determined from three different aspects :

1. Sanitary efficiency.
2. Agricultural efficiency.
3. Economic efficiency.

*Existing conditions in rural India (with special reference to Bengal).*—In most of the villages people have no latrines and they use the fields, banks of tanks and ponds and other vacant land for evacuation. In some of the more advanced villages there are bucket latrines maintained by local bodies or union boards. These local bodies in most of the villages have no means of maintaining first-class sanitary conditions and in many cases these latrines are cleared twice or thrice a week and the night-soil is simply dumped into low lands outside the village. This practice, combined with the unsatisfactory sources of water supplies, which in many cases are from polluted tanks, leads to frequent outbreaks of cholera and other epidemic intestinal diseases.

Composting has often been suggested as a method for safe disposal of night-soil for rural and semi-rural areas. However, there are various problems which must be solved and more research carried out before composting can be successfully applied in practice.

The following are some of the factors which influence the choice of a system of composting:—

1. Rainfall.
2. Humidity.
3. Sub-soil water level.
4. Seasonal temperature variations.
5. Social customs.

Before composting can be successfully introduced as a public health measure in a particular area, it is desirable to have scientific investigations on the following lines and considerations :—

*Materials.*—The type of refuse available is very important. In many rural areas in India the only types of refuse available are grass, shrubs and vegetation removed from tanks.

There is very little kitchen refuse, and the little that is available is given to domestic animals, such as cows and dogs. In many places water hyacinth is available in enormous quantities throughout the year, and is sometimes removed by the villagers and is heaped up by the side of tanks, but unless the hyacinth can be disposed of, the seeds are again washed into the tanks, where they soon germinate and fill up the tanks. If composting could be carried out with such materials, it would have the additional advantage of giving an impetus to the people to keep their waterways clear.

Composting of water hyacinth however presents certain difficulties. When hyacinth is dried it becomes fibrous, like sugarcane trash, and takes a long time to decompose, unless some other materials are added. It may be possible to decompose it properly by starting the process

with moist green hyacinth. In such a case, however, the temperature may not be suitable to keep the sanitary efficiency at a high level. The high calcium and potassium contents of hyacinth, if successfully conserved in a compost, would make a good fertilizer. It is thus both a public health as well as an agricultural problem. The author carried out several experiments using such materials and cowdung as a starter. However, the rise in temperature was never satisfactory, and so far as the sanitary efficiency was concerned the experiments were a complete failure.

*Sanitary efficiency of composting.*—Composting has mostly been studied so far from an agricultural point of view, the appraisal of the sanitary efficiency having been judged by a mere visual inspection of fly-breeding. A scientific investigation of sanitary efficiency should include the following studies:—

(a) *Fly-breeding.*—It will be necessary to devise a suitable sampling technique as otherwise sampling errors are very large owing to the tendency of the larvæ to congregate in particular places in the heap. The species as well as the number of the flies should be studied.

(b) *Temperature records.*—The rise in temperature inside the heap is an index of the sanitary efficiency as it is due to the rise in temperature that most of the pathogenic organisms are destroyed. Temperatures should be recorded not only at different places of the heap but also at different depths.

(c) *Helminthological studies.*—The survival of ascaris eggs, hookworms, etc., and their viability may be used as guides to the sanitary efficiency of a system.

The following conclusions regarding the sanitary efficiency of aerobic composting were reached by Winfield *et al.* (1939) in their experiments in the Cheeloo and Yenching Universities in China :—

*Fly-breeding.*—The amount of fly-breeding was measured by determining the number of larvæ, pupæ and pupal skins present per cubic foot of material. Because of the tendency of larvæ to concentrate in certain parts of the stack while active and to seek special places, which for some species involves leaving the stack, to pupate, sampling variations are very large. Quantitative data are therefore only very rough measures of the intensity of fly-breeding.

It is impossible to prevent fly-breeding entirely in stacks which contain 60 per cent or more of faeces. If stacks are made with 40 or more per cent of vegetable matter and a 5, 10, 18-day turning schedule is followed, it is possible to prevent entirely maggots from reaching maturity. A large percentage of the larvæ leaving the stacks to pupate are killed by ants or eaten by birds if the ground around the pits or stacks is hard packed.

*Ascaris eggs.*—This method of composting is quite efficient in destroying ascaris eggs, and all or almost all eggs can be killed by this process.

At the same time emphasis is laid on the fact that intelligence and care must be exercised to obtain satisfactory results, and certain precautions must be taken for overcoming special difficulties.

*Protozoan cyst destruction.*—*Entamoeba histolytica* cysts are usually present when the stacks are made but they do not persist as long as the time of the second turn though they have been found at the first turn. *Entamoeba coli* cysts on the other hand persist longer, having been demonstrated at the second and third turns.

Winfield's experiments regarding anaerobic composting (Edelmit process) provided conflicting results, but they suggest that there is enough evidence of merit to warrant a more extensive study of the method.

For ensuring sanitary conditions, care should be taken to reduce handling of night-soil to a minimum. The author suggests a night-soil cart of special design having rotating blades inside, so that water can be poured into the tank and the night-soil liquified by rotating the blades. There should be a flexible pipe connection from the bottom of the tank so that liquid night-soil can be sprayed directly on the compost heap.

*Agricultural efficiency.*—Successful composting technique lies in producing a fertilizer with a high nitrogen content. However, the fertilizer value can not be judged on chemical analysis alone, and has to be determined by actual plot experiments, noting the yield of crop, etc.

Chemical analysis of compost should include determination of carbon, nitrogen, phosphate, carbon nitrogen (C/N) ratio, organic matter and moisture content.

The following conclusions were reached by Winfield *et. al.* (1939) regarding aerobic composting :—

There was a heavier loss of nitrogen in the faeces-straw group of experiments as compared with village unit group, at all C/N ratios. Optimum C/N ratio is 38 or 39 : 1.

When C/N ratio of 40 to 1 is exceeded the amount of nitrogen lost increases, and, if this latter point is true, it is of very great significance for agricultural sanitation, since it indicates that the fly-control level of composting faeces and straw is also the level of maximum nitrogen conservation. C/N ratio is probably more important in determining variations in nitrogen conservation within any one group of experiments than in any other factor.

Acharya in Bangalore (1939) carried out comparative experiments on different methods of composting, which, when judged by plot trials in the fields and by nitrification experiments in the laboratory, showed the superiority of the hot fermentation process (modified Edelmit process) over the usual aerobic methods. The former gave a higher recovery of organic matter and of nitrogen than the latter (about  $1\frac{1}{2}$  times) and the resulting manure was equally efficient in crop production and in several cases superior.

*Economic efficiency.*—In many countries, including India, the disposal of household waste and faecal materials has been considered as an expense which must be borne by the community. With a very few exceptions, faeces has never been utilized directly in agricultural practice in India. The economics of composting in India, therefore, would not be the same as in North China where the farmer is so conscious of the value of human excreta, and the practice of using faeces is so thoroughly entrenched, that changes in procedure must be justified purely on grounds of agricultural merits and economy.

In most of the provinces in India there is very little demand for compost manure, although the land needs it badly. The reason for this is the great prejudice against night-soil, so much so, that the mere knowledge that the manure had been prepared from night-soil, however innocuous the final product might be, would prevent the people from touching it. Due to lack of demand for this kind of manure, the saleable value of compost is almost always much less than its production cost, and instances are not rare where many municipalities were thinking of abandoning this system of disposal for want of space due to accumulation of innumerable heaps of undisposed-of compost.

The solution lies in a vigorous campaign of education and practical demonstrations by the agricultural departments on the value of compost manure. A very much wider publicity is essential, and unless the people can be made conscious of the value of compost manure, and a demand is created for its wider use, the system will never fully succeed as a solution to our public health problems, notwithstanding any high degree of perfection we might reach in its technique.

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#### ADMINISTRATION REPORT OF THE PUBLIC HEALTH DEPARTMENT, GOVERNMENT OF TRAVANCORE, FOR THE YEAR 1116 M. E. (DECEMBER 1941)

THE usual activities of the department such as the control of communicable diseases and the registration of vital statistics were continued. The number of births registered was 114,487 which is 2,521 less than in the preceding year. The birth rate per mille of the population was 18.86 as against 19.01 in 1,115. The number of recorded deaths and the death rate per mille of the population were 69,248 and 11.41 as against 59,406 and 9.65, respectively.

There was no plague or cholera during the year. The incidence of malaria was lower than in the preceding year. One thousand four hundred and seven attacks of smallpox and 582 deaths therefrom were reported. There were 3,066 cases of typhoid, of which 360 were fatal.

The vaccination campaign was continued. About 24.36 per cent of the people were vaccinated, including cases of primary as well as subsequent vaccination.

There was no plague among men, but a few rat-falls on account of plague-infection occurred at Munnar, Alleppey and Quilon. The situation, however, was soon brought under control and rat-plague was eliminated.

The temporary post of malaria special officer was abolished during the year, the district health officer, Southern District being put in charge of the anti-malaria measures as well.

In January 1941 sanction was accorded for the opening of a clinic for the treatment of filariasis at Shertallay. It is noted that the clinic commenced work recently.

The health unit, Neyyattinkara, was free from cholera and smallpox. Sporadic cases of typhoid fever, however, occurred throughout the year. The usual activities of the health unit, such as maternity and

child welfare work, medical inspection of school children, etc., were continued.

The maternity and child welfare service in rural areas was continued as usual. The midwives in charge of the centres carried on the work of visiting homes and giving advice to women in various stages of pregnancy and confinement. The number of visits they paid was 52,346 and they assisted at 1,202 deliveries.

The medical inspection of school children was also continued. Two hundred and seventy-four schools were visited by the staff and 42,712 pupils were examined. Various defects were observed in 21,252 pupils of whom 17,354 received the necessary treatment.

Public health education was carried on as usual. Altogether 3,525 lectures and group-talks were organized, reaching an audience estimated to be 279,800 strong. The number of pamphlets and posters issued was 10,991.

In the field of rural sanitation the main feature of the work during the year under review, as in the preceding year, was the effort to popularize bore-hole latrines. Six hundred and seventy-two latrines were constructed.

The receipts and expenditure of the department were Rs. 6,431-5-2 and Rs. 2,83,210-0-5, respectively.

## Current Topics

### Sulphathiazole Treatment of Gonorrhœa in the Male

By ELWOOD A. JENKINS, M.D.  
and

WILLIAM L. SHERMAN, M.D., F.A.C.S.

(From the *Urologic and Cutaneous Review*, Vol. XLVI, January 1942, page 6)

SULPHATHIAZOLE was synthesized by Fosbinder and Walter in 1939. It has been shown that sulphathiazole is rapidly excreted from the human body. About 90 per cent can be recovered from the urine in 24 hours. Little of this is in the acetylated form in contrast with sulphanilamide and sulphapyridine. Many observers have noted that the satisfactory therapeutic action of sulphathiazole in gonorrhœics does not depend upon a high blood level as is the case with other sulphonamide drugs.

This paper is based on a study of 300 cases of gonorrhœa in the male. No medication except sulphathiazole was employed in this series. No blood level studies were taken on any of these patients. We feel that the low dosage employed would have given very low readings. We know from previous experience that sulphonamide derivatives are efficient in low doses, even when blood titres are zero. Also, there is less likelihood of untoward reactions and toxæmias. Since all of our patients are ambulatory, most of them employed and many driving cars, it would not be safe to give them large doses.

This work was done at the Social Hygiene Clinic, Detroit Department of Health. An idea of the clinic load may be obtained from the following statistics for the month of May 1941:—

|                                  |        |
|----------------------------------|--------|
| New cases admitted               | 610    |
| New cases diagnosed as gonorrhœa | 361    |
| Cultures taken for gonorrhœa     | 1,390  |
| Smears taken from gonorrhœa      | 2,566  |
| Treatments given for gonorrhœa   | 2,186  |
| Total patient visits             | 11,055 |

Every patient reporting to the clinic with gonorrhœa is given an individual educational interview with emphasis on the seriousness of the disease and its possible complications. Most of these patients appear

to regard their disease lightly. Forty-two per cent gave a history of having had previous infections. Although some of these may have been recurrences it would not seem that gonorrhœal infection tends to alter or improve a person's social behaviour sufficiently to prevent his acquiring the disease again. Under such a clinic load it is apparent that patients can report routinely but once a week.

Further analysis reveals that 82 per cent were coloured, the remainder white. Seventy-eight per cent were single. Of the 300 cases who started treatment 239 completed the course as outlined, a lapse of only 20 per cent. Pelouze claims that usually 80 per cent of dispensary patients lapse treatment. We feel our success in holding the patients may have been due to: (1) they were able to see favourable results of treatment early, (2) the treatment was simple to follow, (3) there were no unpleasant reactions and (4) the individual educational interview given by the nursing staff.

The subsequent statistics in this report will be based on the 239 patients who completed the course as outlined.

|  |             |
|--|-------------|
| History of one or more previous infections | 42 per cent |
| Complications on admission                 | 52 "        |
| Prostatitis                                | 18 "        |
| Epididymitis                               | 7 "         |
| Arthritis                                  | 0.8 "       |

The complicated cases made rapid and satisfactory progress. The average time to effect a cure in this group was five weeks, in spite of complications.

The diagnosis was based on the history, clinical symptoms, signs and positive bacteriological studies. All of the patients had a urethral discharge on admission which showed Gram-negative intracellular diplococci and the culture was positive for gonococci. We have been using an inexpensive practical method for the culture of gonococci (Difco) both for diagnosis and as a criterion of cure. The course of treatment consisted of sulphathiazole 1 gramme three times a day for five days, a total of 15 grammes. The patients were seen at weekly intervals or until five consecutive negative prostatic smears and two negative prostatic cultures were obtained.

Tests of cure were five negative prostatic fluid smears, two negative prostatic fluid cultures, alcohol,



and sexual excitement. The patients were re-checked one month after dismissal from the clinic for any evidence of clinical or laboratory recurrence.

Two hundred and twenty-eight or 95 per cent of the patients were discharged as cured. The discharge stopped in the majority in less than four days. All of the 228 had negative prostatic smears in one week and every one had five consecutive negative slides within five weeks. However, we know from subsequent study that cultures become negative in one week or less.

There were no complications in those responding to treatment after sulphathiazole was started. Only one patient developed a slight dizziness from the drug, but he did not have to discontinue it.

Of the 11 drug failures all but one gave a history of previous infection; and he had no apparent complication on admission. The other drug failures were patients that had failed to respond to sulphanimide or sulphapyridine.

The following is a comparison of our results with those of other reported series:—

|                            | Number of cases | Per cent of cures |
|----------------------------|-----------------|-------------------|
| Sherman and Jenkins ..     | 300             | 95                |
| Burkholder and Bang ..     | 100             | 92                |
| Hibbs, Day, Jung and Brady | 57              | 94.74             |
| Knight, Uhle and LaTowsky  | 50              | 96                |
| Stockwell .. ..            | 30              | 100               |
| Culp .. ..                 | 21              | 80.9              |

#### Conclusions

Sulphathiazole is a very effective therapeutic agent for the treatment of gonorrhoea in the male.

It is apparently the least toxic of the sulphonamide drugs to date. There was only one slight reaction in 300 cases.

Sulphathiazole is potent in the low dosage of 1 gramme three times a day for five days. However, we feel it is better to continue the drug for ten days to two weeks as an extra precaution.

In the majority of cases the urethral discharge will stop within four days or less. If the discharge does not stop within a week the case should be classed as drug failure, in our opinion.

### The Allergic Approach to Epilepsy : A Critical Review

By D. C. DEWAR, M.D., D.P.M.

(Abstracted from the *Practitioner*, Vol. CXLVII, December 1941, p. 776)

THE author draws attention to the fact that certain types of idiopathic or essential epilepsy rest on a sensitization basis, and recommends an exhaustive allergic investigation in all cases of epilepsy in which there has been a failure to respond to other methods of treatment. Especially is this urged when there exists either a personal or familial history of other allergic phenomena. Epileptics, as a class, have been shown to exhibit a greater degree of protein sensitivity than either psychotic or control groups, as evidenced by the greater percentage among them of positive skin reactors, and the higher incidence of other forms of allergy.

Allergic epilepsy displays the criteria common to allergy occurring elsewhere, viz.:—

- (1) Multiple sensitivity.
- (2) Alleviation of symptoms following elimination of the guilty substance.
- (3) Recurrence of symptoms on re-introduction of the substance.

In view of the established association of epilepsy and allergy, in a proportion of cases, it would appear strange that further systematic investigation along similar lines

has not been attempted. Such a line of research would present distinct possibilities.

The keynote of treatment has been, whenever practicable, the complete elimination of the offending protein. The detection of this protein, however, is not always simple and may be impossible. In such cases diet elimination tables, as compounded by Rowe, may be utilized as an aid to diagnosis and treatment. Non-specific desensitization has given good results in the hands of some workers, notably Spangler. In those few cases in which specific desensitization has been attempted uniformly favourable reports have followed. This latter method seems to invite further consideration, either alone or combined with elimination.

From a prophylactic point of view the early recognition of the hypersensitive state is most important, and undoubtedly the bulk of the work done and successes achieved have been with young subjects, in whom sensitivities are more readily detected and influenced. Nevertheless, this is not sufficient reason to condemn, without trial, the adult epileptic, whether institutionalized or not, and it is here that there exists a considerable field for further study.

A few investigators have been unable to find, on repeated examinations, any evidence to support the contention that epilepsy and allergy are related.

### Some Effects of Vitamins B and C on Senile Patients

By W. STEPHENSON, Ph.D.

C. PENTON, B.M.

and

V. KORENCHEVSKY, M.D.

(Abstracted from the *British Medical Journal*, Vol. II, 13th December, 1941, p. 839)

Forty senile patients were treated with the vitamin B complex and vitamin C, the whole period of observation lasting for about a year. B complex was given as dried yeast in single doses of 25 grammes 3 times a week. The yeast was supplemented by tablets of aneurin (B<sub>1</sub>) 5 or 3.3 mg., lactoflavin 5 or 3.3 mg., and nicotinic acid 50 or 33.3 mg., in each case administered three times a week.

Vitamin C was given as pure ascorbic acid, 200 to 300 mg., three times a week. The condition of these patients was compared with that of 18 senile patients of a control group receiving dummy tablets. All patients were on a usual hospital diet not rich in vitamins.

Treatment with vitamins B and C, as with any other remedy, did not stop the biologically inevitable development of senility, and therefore did not affect those basic features which are specific for and present in even the most physiological type of senility.

By treating the aged people with vitamins, however, it was possible to prevent or improve, in some cases to a striking degree, certain of these senile features which could be considered as pathological, because they appear prematurely or in an extreme degree (e.g., muscular, cardiovascular, and mental deterioration) or which do not seem to be inevitable in normal physiological senility (e.g., dementia, insomnia, skin rashes and itchings, constipation).

During the period of observation improvement or disappearance (apparently not of a lasting nature) of some pathological senile features was observed in numerous cases, while a number of other cases were not improved by the treatment, and a few patients who had been free from certain senile features developed them during and notwithstanding the treatment.

In spite of the comparatively limited and modest results which aged people might expect from treatment with vitamins, it seems clear that in suitable cases the relief obtained in some pathological senile features might be considerable.

The authors believe that their results provide strong support to the argument, repeatedly emphasized by several specialists in the modern science of nutrition,

that the greatest care should be taken to prevent the occurrence of partial or latent vitamin deficiency, apparently widely spread in the population. This will result not only in the prevention of certain vitamin-deficiency diseases but probably also in the approach to a less pathological senility.

### An Investigation of the Effect of Diet on the Course of Experimental Malaria in Monkeys

By R. PASSMORE, B.M., B.Ch.  
CAPTAIN, I.M.S.

and

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(Abstracted from the *Journal of the Malaria Institute of India*, Vol. III, December 1940, p. 447)

It has often been stated that malaria runs a more severe course in people who are ill-nourished and in poor health than in those who are well fed and healthy. As such statements are matters of opinion rather than the result of controlled experiments, the authors decided to make observations on the course of monkey malaria in well-fed and under-fed animals. Monkeys (*Macacus radiatus*; syn. *Silenus sinicus*) were kept for varying intervals on two different diets. In the one there was a resemblance to a good human lacto-vegetarian diet as consumed by certain groups in Northern India. It was based on whole wheat and contained liberal amounts of pulses, vegetables, fruits and milk. The other diet resembled that of poor rice eaters all over India. Its main ingredient was parboiled milled rice and only small amounts of pulses, vegetables and fruits, but no milk were included.

The monkeys on the first diet put on weight and remained in excellent condition, while those on the poor diet lost weight steadily, some dying within 6 or 8 weeks. The majority, however, survived for 6 to 12 months and then died, after suffering for several weeks from diarrhoea associated with inflammatory or degenerative changes in the small intestine. The monkeys of the first group were active and playful, while those of the second group were listless and uninterested in their surroundings. The two groups were thus clearly differentiated. When animals in the two groups were infected with malaria by the injection of equal doses of parasites (*Plasmodium knowlesi* or *P. cynomolgi*) there was little if any difference in the reaction. The course and severity of the primary attacks of malaria were unaffected by the differences in the state of nutrition of the monkeys.

### Discussion on the Therapeutic Value of Transfusion of Derivatives of Blood

By L. E. H. WHITBY, C.V.O., M.C.

J. VAUGHAN

and

H. BROWN

(Abstracted from the *Proceedings of the Royal Society of Medicine*, Vol. XXXIV, March 1941, p. 257)

(I) TRANSFUSION is practised for two main reasons:—

1. To restore oxygen-carrying capacity.
2. To restore blood volume.

On rare occasions transfusions are given with a view to contributing leucocytes, platelets and other clotting elements, and for immunological purposes. Stored blood and blood derivatives are extremely efficient for blood volume restoration. Red corpuscles, either from fresh or stored blood, are essential for increasing oxygen-carrying capacity. The survival time of the red cells of stored blood is a function of their fragility. Up to 3 or 4 weeks stored blood has quite good

oxygen-carrying power and when under a week old it can be regarded as almost the equivalent of fresh blood from this point of view; stored blood and its derivatives, however, are useless for contributing leucocytes, clotting factors and immune bodies. Leucocytes perish within a few hours, clotting elements deteriorate within a few days, immune bodies and complement slowly decline.

The corpuscles of young stored blood are available for the preparation of concentrated red cell suspensions used for the treatment of anaemia. They provide the maximum increase in oxygen-carrying power rather than blood volume increase.

The experimental survey, carried out by the Army Blood Transfusion Service in a search for the best blood derivatives for use in resuscitation work, gave the order of preference of the various fluids tried as plasma, serum, haemoglobin-Ringer, gum saline, isotonic saline. The plasma used contained 4 to 5 per cent protein, sterility being ensured by Seitz filtration.

A hundred air-raid casualties have been studied, and 165 pints of plasma administered, with only 3 rigors. The maximum amount given has been six pints. Where large transfusions are needed it is an advantage for at least 1 pint in 3 to be of blood. In 24 cases the efficiency of citrate plasma for approximately quantitative replacement of blood loss has been unequivocal. The quantitative nature of the replacement must be controlled by blood pressure examinations. Experience has shown that the need for transfusion rarely ends in the resuscitation ward.

(II) In the area served by the N.W. London Blood Depot the following blood derivatives have been used: unfiltered plasma, filtered plasma, filtered serum, dried serum reconstituted with sterile distilled water.

Two mild rigors were noted in 26 cases treated with unfiltered plasma and 2 rigors in 83 cases treated with filtered plasma. Seven cases have been treated with liquid serum, with 2 rigors. Ninety-one injections of reconstituted dried serum have been given, with 19 reactions, mostly when the serum was given in concentrated form. All the products gave the impression of being effective in the treatment of shock.

For air-raid casualties, combined treatment with blood and a blood derivative seemed to be indicated, as anaemia was usually present, even when there was no obvious haemorrhage. In the treatment of burns the administration of concentrated serum has reduced the local oedema. The results, however, of using concentrated serum in nephrosis and nephrotic oedema have been disappointing.

Apart from clinical considerations, serum is an easier fluid to handle in large quantities than plasma, as the latter is readily infected and tends to form clots. The use of concentrated red cell suspensions for anaemia with normal blood volume is advised.

### Experience with the Intravenous Use of the Follicle-Stimulating Hormone of the Anterior Pituitary in Menstrual Disorders

By M. KENNY, M.R.C.O.G.

and

D. DALEY, M.D.

(Abstracted from the *Proceedings of the Royal Society of Medicine*, Vol. XXXIV, October 1941, p. 804)

THE authors have attempted to test the efficacy of follicle-stimulating hormone from pregnant mares' serum in cases of metropathia haemorrhagica, menorrhagia and secondary amenorrhoea. Five hundred units of Gestyl (Organon Ltd.) were injected on three consecutive days after testing for serum sensitivity. Results were controlled when possible by endometrial biopsy.

#### Results

(A) *Metropathia haemorrhagica*.—Four cases were treated. Regular menstruation has been induced in three cases and continued for at least a year in each.

One case was resistant to this as to all other treatment given. Two successful cases had had long-continued treatment by other methods with no improvement. One case relapsed when her house was bombed after apparent cure for a year. Ovulation was probably produced in all three successful cases and was confirmed by endometrial biopsy in two of them.

(B) *Menorrhagia with ovulation*.—There was definite clinical improvement in the two cases treated.

(C) *Secondary amenorrhœa*.—Three cases were treated with one success. The successful case was 29 years old and had had three years complete amenorrhœa. Oestrogens were given for three months and oestrin-withdrawal bleeding was produced. Gestyl injections in the 4th month were followed by regular periods lasting three days each month. This cycle has continued for 11 months. Biopsy to confirm ovulation has not been possible.

The results are as yet inconclusive but appear to be sufficiently encouraging to warrant an extended trial of treatment by intravenous follicle-stimulating hormone in menstrual disorders, especially those associated with absence of ovulation.

### Preparation and Use of Concentrated Red Cell Suspensions in Treatment of Anæmia

By G. E. O. WILLIAMS, M.D.

and

T. B. DAVIE, M.D., F.R.C.P.

(Abstracted from the *British Medical Journal*, Vol. II, 8th November, 1941, p. 641)

THE modern method of blood storage involves the separation of plasma from stored citrated blood. This plasma can be stored for long periods, but the remaining red cells are usually discarded. Owing to their potential value in the treatment of anæmia, however, they have recently been used in increasing amounts for separate transfusions.

By using a long needle thrust through the rubber caps of the blood bottles, plasma can be separated aseptically for bottling and storage. The red cells can be similarly transferred into sterile bottles, each full bottle of concentrated blood thus containing cells from two or three donors.

Concentrated blood prepared in this way varies in composition, but approximately consists of 8,500,000 red cells and 3,000 leucocytes per mm.<sup>3</sup>, the hæmoglobin being 150 per cent. The cells are more fragile than normal, and the suspension is more viscous than whole blood of normal strength. It should therefore be given within 48 hours of preparation, and administered slowly to avoid cardiac embarrassment. Otherwise it may be given by the same method as plasma or whole blood.

Seventy-seven transfusions were given, most of them consisting of over 1 litre concentrated blood. Results, in terms of percentage increase in hæmoglobin, were obtained in 35 cases, and for comparison adjusted to equivalents of 'standard transfusions' of 500 cm.<sup>3</sup> of concentrated blood.

Results :—

| Type of anæmia                                   | Number of cases | Mean rise of hæmoglobin % per 500 cm. <sup>3</sup> of concentrated blood given |
|--|-----------------|--|
| 1. Post-hæmorrhagic                              | 17              | 14.3   |
| 2. Associated with severe infection.             | 6               | 9.6  |
| 3. Associated with pregnancy and the puerperium. | 4               | 10.8   |
| 4. Dyshæmopoietic                                | 8               | 8.0  |

In 77 transfusions, 15 reactions were noted. Of these seven produced rigors, and the others were mainly simple rises of temperature. One fatal reaction, probably of allergic origin, is fully reported. This reaction rate was lower than that produced by transfusions of whole blood during the same period of observations, when abnormal conditions caused a greatly increased reaction incidence.

### Paratyphoid B and Acute Gastro-Enteritis

By S. H. WARREN

(Abstracted from the *Public Health*, Vol. LIV, May 1941, p. 139)

OUT of 64 persons who shared in a wedding feast at Consett on 8th June, 1940, as many as 56 were infected with the paratyphoid B bacillus. Of these 41 developed clinical enteric fever type of illness, 9 had only early acute symptoms and 6 had no symptoms at all. Of the 41 cases, in 34 there were preliminary symptoms, beginning within 12 to 72 hours, of diarrhoea, vomiting and abdominal pain. These 43 cases (i.e., 34 + 9) at their onset appeared to be ordinary acute bacteriological food poisoning. Throughout only paratyphoid B was found and the agglutination titres suggest that this was the only organism present. The epidemiological enquiries implicated a home-made trifle. This was prepared by a woman later found to excrete profusely paratyphoid B bacilli in both fæces and urine. It had been kept overnight at atmospheric temperature during a spell of particularly hot weather. The woman continued to excrete the bacilli for five months. While it is possible that she was infected from the trifle it is suggested as probable that she was suffering from an ambulant paratyphoid infection at the time of its preparation. (The high proportion of cases with acute gastro-enteritis is of great interest and is no doubt associated with very massive infection of the food, thus allowing the naturally low irritant properties of *Bact. paratyphosum B* to operate by their cumulative effect.)

### Caloric Requirements of Full-Term and Premature Infants in the Neonatal Period—A Formula, its Uses and Limitations

By H. M. M. MACKAY

(Abstracted from the *Archives of Diseases of Child*, Vol. XVI, September 1941, p. 166)

THE day-to-day caloric needs of new-born babies is a subject which has been much neglected and about which textbooks provide the most diverse statements. In this paper the caloric value of colostrum and early human milk is discussed. Its value is taken in the author's calculations as 20 per fluid ounce (about 30 cm.<sup>3</sup>), though individual variations may be considerable.

A formula is suggested whereby the food intake of new-born babies may be regulated. According to this the baby should receive on the first day of life calories equivalent to  $1/2 \times 110 \times \text{birth-weight}$  in kilograms, and his feeds should increase by this same amount each day of the first week, so that by the seventh day of life he would be given 110 calories per kilogram birth-weight. It is pointed out that the formula over-estimates the intake of normal breast-fed babies during the first two days when breast secretion is scanty. In the second week of life 110 calories per kilogram birth-weight was taken as the usual requirement. The importance is emphasized of using these figures simply as guides and not to enforce a rigid system of feeding;

If the baby is artificially fed the rate of increase must often be rather slower, especially in the first four days: certainly if there is any tendency to vomit or the baby's abdomen is distended a more gradual increase is indicated perhaps reaching 110 calories per kilo birth-weight about the tenth day of life.

The calorie intake of twenty healthy breast-fed babies at the Mothers' Hospital, Clapton, London, has been compared with the quantities calculated from this formula. The average intake on any one day after the first two days of life, of those who regained their birth-weight by ten days old, was found to be within 3 to 12 per cent of the schedule. Three other series of full-term babies making good progress, whose average food intake for the first ten days has been recorded by different workers, received in these ten days a total quantity within 1 to 8 per cent of the formula requirements: those who took larger quantities in the first days of life tended to take less than others in the latter part of the first ten days, and vice versa.

Calculations from test feeds on twenty-five full-term babies showed that estimates of total intake based on the feeds given during the duty-periods of the day staff gave, on the whole, a fairly accurate figure for the twenty-four-hour intake, hence three or four test feeds in the twenty-four hours should generally provide an adequate check on a baby's intake.

One hundred and seven consecutive premature babies at the Mothers' Hospital, who had their food intake checked and guided by the formula, made good progress and averaged one ounce (30 grams) over their birth-weight at ten days old.

For a group of forty-three premature babies in this series complete figures are available. Their birth-weights varied between 1.125 kg. and 2.5 kg. and their intake for the first ten days was within 6 per cent of that allowed by the formula. During the second week of life, the intake averaged 117 calories per kg. birth-weight per day, *i.e.*, again within 6 per cent of the formula requirement.

All artificial feeds were given in a strength to provide approximately 20 calories per fluid ounce (30 cm.<sup>3</sup>). Dilute feeds were not given. The fluid intake was augmented by giving water to full-term babies during the first three to five days of life or longer, to premature babies generally during the first fourteen days. Premature babies during the first two to five days received water between feeds in about the same volume as provided in their feeds.

The author expresses the hope that wide adoption of a scheme for calculating the approximate calorie needs of new-born babies may bring about a fall in the neonatal death rate, as well as improved health in the subsequent months, by contributing to better management in the most critical period of life.

### The Treatment of Burns

By T. E. WILSON, M.D., M.S., B.Sc., M.R.A.C.P.  
(From the *Medical Journal of Australia*, Vol. I,  
31st January, 1942, p. 131)

WHILE there are more than a few surgeons who complacently regard the result of their treatment of most diseases as satisfactory, probably none would dare to affirm that the immediate or late results of their treatment of other than the mildest of burns were such that further improvement was unlikely. The increased interest in the subject of burns now being displayed in England, as exemplified by the discussion at the Royal Society of Medicine, London, on 6th November, 1940, and the improved results which have followed and which will in the future undoubtedly follow this interest, are a few of the minor benefits which we may hopefully expect to derive from the present war.

#### Shock, toxæmia and sepsis

The three well-known factors responsible for the fatalities accompanying burns are shock, toxæmia and sepsis. The last-mentioned is often quite obviously due to hæmolytic streptococci; but as to the causes of the other two, shock and toxæmia, while there are many theories, no agreement has yet been reached. The application of coagulants to burnt surfaces was

certainly a notable advance in the treatment of burns. This method was introduced to lessen the dangers of the triad shock, toxæmia and sepsis, and except in certain situations and types of burns in which its use is ineffectual or dangerous this type of treatment relieves pain, lessens the exudation of fluid, decreases the autolysis of the tissues and produces conditions inimical to the growth of bacteria. Morphine and warmth are the essentials in the treatment of primary shock, whereas in secondary shock, since the most potent factor in its causation is the great loss of plasma from the burnt surfaces and into the tissues (the latter being the more important of the two), intravenous administration of plasma or serum is indicated in order to raise the plasma osmotic pressure, to maintain the normal distribution of fluid between the blood and the tissues and to reduce the hæmoconcentration of the blood.

Wilson found a lowering of the serum sodium level during secondary shock following burns, and treatment with desoxycorticosterone acetate tended to elevate the serum sodium level, with coincident improvement of the patient's clinical condition. Wilson therefore recommended the use of this drug in addition to plasma transfusions in the treatment of severe shock. The use of the 'B.L.B.' mask to attain a high alveolar oxygen tension has helped to lessen the mortality rate from shock and to reduce the incidence of fat embolism (quite a frequent occurrence in fatal cases of burns). This high alveolar oxygen tension is also of importance if in addition to the burn there is an associated 'blast lung'. Glucose infusions, even in large quantities, scarcely affect the hæmoconcentration and are indicated only to protect the liver during severe toxæmia. Even then, only small quantities should be used. Aldrich suggested that the acute toxæmia of burns was due to infection by streptococci; but while infection undoubtedly frequently plays a part in the production of the toxæmia of burns in the majority of cases, there are some cases in which the toxæmia develops in the absence of infection. According to Wilson, the hypothesis of absorption of autolytic products from the burnt area is not proven. The most serious objection to it is that completely aseptic autolysis does not produce potent toxins. Although the toxæmia of burns, when fatal, is always accompanied by bacterial infection, yet liver lesions such as are found in these fatal cases of burns are never produced by common bacterial infections, even of the most severe type. It may be, however, that infection and absorption together result in the production of the toxæmia. The coagulation of the surface of the burn definitely inhibits the growth of the organisms and diminishes the absorption from the burnt area, and should therefore be doubly effective in lessening toxæmia. If a serious attempt is to be made to reduce the incidence of sepsis in burns, the burnt area should be treated by the same careful aseptic routine method, both for the first and for later dressings, as an ordinary wound would be.

#### Treatment

Professor McIndoe has pointed out that coagulation therapy has often been used in cases in which it is unwarranted or in which it is definitely contra-indicated. The production of a coagulum over a burnt area has been likened by Hudson to primary suture of a surgical wound without drainage, and therefore such treatment should not be used indiscriminately. When the burn is of only the first or the second degree, the method of coagulation gives excellent results provided that sepsis can be excluded. In cases in which the loss of skin is of the third degree (that is, full thickness), it is impossible to coagulate the whole burnt area and sepsis inevitably occurs beneath the superficial coagulated layer. Thus, instead of being extinguished, the septic process may be considerably enhanced with the result that months may elapse before the slough separates. Even then, healing is painful and accompanied by dense scarring, anæmia and general debility of the patient. Localized third

degree burns are probably best treated, in the light of present knowledge, by immediate excision and grafting. If they are too extensive for excision, the best treatment then available is either the recently described envelope method or the use of saline baths and saline dressings, followed in each case by grafting. In this war most of the burns have been on the exposed parts of the body (the hands and the face), areas usually unsuitable for coagulation therapy. Because the tannic acid jellies when used at the first-aid posts are often applied hurriedly and inadequately over unclean burnt surfaces without any consideration of the depth of the burn, McIndoe recommends a simpler application, such as gentian violet jelly, with which it is usually possible later to determine the depth of the burn. An Emergency Medical Services memorandum issued by the Medical Research Council of the Privy Council suggests that after being cleansed and dried the burnt area should be dusted with sulphanilamide before the coagulant is applied. After the use of tannic acid preparations as the final dressing in special situations, such as on the hands, movement of the fingers may be limited for months and pressure effects may develop. As McIndoe pointed out, the œdema developing beneath the coagulum as a result of the burn immobilizes the tendon sheaths very early and is a definite factor in causing fixation of the joints. Sepsis, when present, further increases the œdema. The pressure effect is also intensified by the fixed encrusted tan which does not yield with the increase in size of the part. Embarrassment of the circulation of the fingers leads to crippling deformities, such as spindle fingers, partial necrosis or even partial loss of digits. A common complication is pressure necrosis of the tissues overlying the proximal interphalangeal joints with perforation into the joints. The final result is then a fixed, clawed, useless hand. Such a chain of events may happen with a burn of the second degree if it is converted into a third degree burn by necrosis. On the eyelids, if the burn is of the third degree, and unless grafting is carried out early, sepsis is inevitable, with rapidly developing ectropion and exposure of the globe, corneal ulceration and perforation beneath the coagulum.

For the first-aid treatment of burns Wakeley favours gentian violet jelly with merthiolate (1 in 5,000). This may be dispensed in a collapsible tube and is therefore unlikely to be spoilt by water, oil, grease, *et cetera*. Being an efficient antiseptic, it has the advantage that it may be temporarily applied to the burnt area without any cleansing, as may be necessary during the stress of battle. It is also painless, soothing and effective. As a coagulating agent the aqueous solution of tannic acid has been almost completely replaced by such combinations as gentian violet (1 per cent), silver nitrate (10 per cent) and tannic acid (15 per cent). Triple dye, which is a solution containing 1 per cent (or 2 per cent) of gentian violet, 1 per cent of brilliant green and 0.1 per cent of neutral acriflavine, is sprayed or painted on the injured surface after cleansing with saline solution and excision of all blistered and dead epidermis. Ether soap should be used for cleansing the burnt area only when an oily or greasy application has been used as the first-aid dressing. At all times it is important that the body of the burnt patient is not unduly exposed during the cleansing and dressing of his burns. This especially applies to the patient on whom it is necessary to use ether soap during the cleansing of the burn. It is said that two or three applications of triple dye will result in a nice, thin, supple tan; but it is sometimes found that several applications are necessary before a suitable tan is acquired. If, as sometimes happens, sepsis appears at the edge of the triple dye tan, cleansing and retanning under anæsthesia are sometimes recommended; but the application of saline dressings over paraffin-impregnated net and grafting later are usually to be preferred, for the burn by the time sepsis develops has become of the third degree. Many authors who advocate the use of triple dye seem to have overlooked the occurrence of infection

beneath the tan; but there is no doubt that in insufficiently cleansed areas it happens frequently. For the late after-treatment of burns, Wakeley suggests that lanolin be rubbed into the healed surface each day for at least six weeks. This massage is said to result in a skin which is more supple and more vascular. In the *Medical Journal of Australia* of 25th October, 1941, de Vidas and McEachern reported the use of a tannic acid jelly containing 7.5 per cent of sulphanilamide. They found that the absorption of the sulphanilamide continued until the coagulum of the tannic acid formed, after which absorption ceased. These results, when translated to the probable absorption of autolysed tissue products, would confirm the advisability of producing a tan whenever possible. Robson and Wallace have recently described the good results obtained with a glycerine-sulphonamide paste containing 'Albucid', glycerine, kaolin and cod-liver oil for local application to burns of the hands and face. On theoretical grounds its use should be attended by good results, and further trial of this paste is indicated. In the treatment of burns of the hands and parts subjected to pressure, good results have followed the use of a single application of triple dye after the burnt area has been cleansed with saline solution, then dried and coated with a layer of flavine emulsion (Australian Pharmaceutical Formulary) about an eighth of an inch thick, the entire part being covered with a bandage which is left undisturbed for seven days. On removal of the dressing after this time, if the wound is not healed the dressing is repeated.

From a consideration of the factors essential in the healing of wounds in general and of burns in particular, Bunyan has evolved a method of treatment of burns which consists of intermittent irrigation with weak solutions of electrolytic hypochlorites. The advantages of these solutions are: (i) their selective action dissolves the dead tissue and stimulates healing tissues; (ii) the breakdown products are salt and oxygen; (iii) the bactericidal powers are great in non-irritant concentrations; (iv) stock solutions are stable and of constant strength; (v) pain is relieved and desensitization is obtained. The method of treatment described by Bunyan consists of hosing down the burnt area with a 5 per cent solution of electrolytic hypochlorites to remove all surface contamination, much of the charred tissue and all the exudates, and to kill most of the bacteria present. A special envelope (Bunyan Standard) is then applied to the part for purposes of irrigation. These envelopes are made of fine silk coated with synthetic resins; they have an inlet and an outlet, and the open end of the envelope may be sealed around the part by adhesive silk, strapping and rubber or pneumatic bands. Bunyan has used various sized envelopes up to those enclosing the body and limbs. Irrigation with 2.5 per cent hypochlorite solution is carried out for twenty minutes three times per day until the infection is overcome, and then twice a day. When necessary, the part may be dried by blowing warm air or oxygen through the envelope. The envelope is left in place until epithelialization is complete. One of the advantages of the method is that the silk of the envelopes is transparent and the process of healing can be followed throughout its course. This method of treatment is also applicable to cases in which extensive burns coexist with compound fractures or multiple wounds. Since his original paper Bunyan has again discussed this method, and up to that time he had satisfactorily treated 200 patients.

In third degree burns the method of soaking off slough by saline packs or by repeated or continuous saline baths produces a clean, granulating surface much more quickly than does the coagulation method. Saline baths for the whole body are useful for extensive mixed second and third degree burns. In the Royal Navy it has been noticed that those men suffering from burns who have been immersed in the sea suffer less pain and shock than would have been expected. The saline bath apparently exerts its beneficial effects whether intended or enforced.



### The sulphonamides

The question of the prophylactic use of the sulphonamides in the treatment of burns has recently received attention. Although this treatment may have little effect on the local septic process, it has been recommended as a protection against the dangers of septicæmia and pyæmia. Bunyan is of the opinion that chemotherapy is usually unnecessary when the envelope method is used, because of the disinfection and the actual prevention of toxæmia and secondary infection by this method. Wakeley also thinks that the sulphonamides are rarely necessary in the treatment of burns, and points out that any vomiting induced by the drugs would further impair the patient's fluid balance. Colebrook differs from these surgeons, for he thinks that there is great benefit to be derived from the local application of the sulphonamides, either as a powder or in some form of paste. In my limited experience it has been found that the local application of sulphanilamide to infected second degree burns was of use only in those cases in which the formation of pus or the exudation of fluid was limited in amount before the drug was applied. If the pus formation or the exudation of fluid was large in amount, eusol or saline pads gave better results than sulphanilamide powder.

### Burns due to chemicals

Special treatment is required for burns due to chemicals. For burns due to phosphorus one application of a 2.5 per cent aqueous solution of copper sulphate followed by drying of the burnt area and then tanning with triple dye is recommended. In the absence of such treatment these burns are apt to become deeper as the phosphorus continues its thermal action on the tissues.

## First Aid Teaching Technique

By C. J. POTTHOFF, M.D.

(From the *Journal of the American Medical Association*, Vol. CXVII, 25th October, 1941, p. 1417)

PRESENT-DAY warfare, with participation by the entire population in the defence and offence effort, necessitates training of the whole population, each segment for its duties. Into the public mind to-day the need for preparation is being instilled, and much thought is being given to devising the direction and method of training. If the whole population is to be trained for the emergencies of war, one of the first objectives will be the training in methods of first aid. In Britain such training has formed an important aspect of defence work. In this country the American Red Cross is even now extending its first aid programme; plans call for an immense expansion of this training.

Without doubt, physicians will play an important part in the local programmes. Red Cross units commonly have physicians among their directors and look to them for guidance in phases of activity related to health work. Whether he has a hand in directing the local programme or whether he actually does the teaching, the physician may find himself in a rôle which he does not ordinarily have, that of participating in classroom teaching. Because of his long experience as a student, as a teacher of the individual patient and perhaps as a public speaker, he will have many qualifications valuable for classroom teaching. Nevertheless such teaching is a specialized procedure, requiring study and practice for mastery, and the physician who is equipped with and applies knowledge of good educational methods should represent the best first aid teacher.

It is possible that some of the training of the physician may condition him unfavourably for certain aspects of first aid teaching. Because of his own experiences, he may rate the pupils too high on the basis of background information and ability to understand explanations and to memorize. Even when warned and wary of dangers, mistakes may occur. In one class, after the topic of broken bones had been

considered, one pupil asked 'Now that we have studied about first aid for broken bones, won't you tell us how to take care of fractures?' This pupil was a college student! On another occasion a pupil asked 'Will digital pressure, applied to the right arm, stop bleeding in the left arm?' The right arm had been used in the class demonstration. Just as the first aider should 'splint 'em where they lie', so the instructor must 'know the pupils'. The beginning instructor almost invariably overrates the pupils as students.

The approach to becoming a good local adviser or teacher in this programme entails (1) acquisition of organized knowledge relating to accident prevention, (2) acquisition of knowledge concerning good first aid procedure, (3) acquisition of knowledge concerning what the public is being taught generally in first aid classes and (4) acquisition of knowledge concerning methods in first aid teaching. Usually first aid courses consider accidents common to civilian life, using the American Red Cross First Aid Textbook. It may be that soon instructors will be provided with additional material based on the experiences in Europe and that thus the course may include topics pertaining especially to prevention and first aid care of disabilities common to warfare. The Red Cross textbook, written with the collaboration of medical men eminent in their respective fields, is exceptionally good. It gives in simple language information concerning accident prevention and first aid procedures. It is not written primarily as a textbook for physicians but rather for lay people. It considers cognitive levels and assimilative abilities of these people.

The Red Cross also issues an instructor's manual. This book is based on the large body of experience of the national organization in first aid procedures and

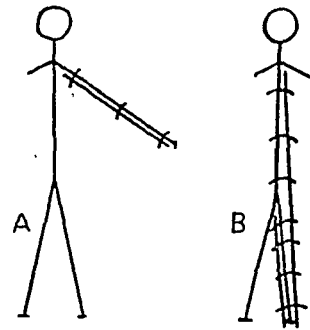


Fig. 1.

A, fracture of elbow with arm straight; B, fracture of femur without traction.

teaching. It allocates the ground to be covered in each lecture, gives lesson plans and suggestions for class management and lists mistakes commonly made by the novice instructor.

During recent years, many lay persons having been trained in first aid, it has been possible to study the effects of first aid teaching, to ascertain whether accidents are reduced, whether graduates do good first aid work and what is the nature of the mistakes made by graduates in their first aid efforts. Conclusions can thus be drawn concerning the improvement of first aid courses.

Many studies show beyond reasonable doubt that first aid training represents an effective way to reduce accidents. Accident prevention is a major objective of first aid training; it is not a will-o'-the-wisp objective but rather one which the instructor may with confidence expect to attain. The trained first aider also handles accidents better than does the non-trained person. Physicians may smile occasionally at the work of first aiders, but by and large the trained person does good work when compared with that of the untrained. And course graduates also commonly have an improved attitude concerning matters of general health.



While the trained lay person does improved work, mistakes are occasionally made. Such mistakes include the following:—

1. He is overwhelmed by the scene of the accident, modifying learned methods to the detriment of the victim's interests.

2. He fails to examine carefully.

3. When the victim has several injuries, the first aider pays attention only to the worst one.

4. He uses splints that are too short.

5. He gambles that the injury is a sprain rather than a fracture.

6. He is too free with the application of a tourniquet.

7. He handles burns poorly.

8. He applies artificial respiration when he should not do so.

9. He does not organize his first aid efforts efficiently and thus copes poorly with shock.

These mistakes suggest three avenues toward improvement of first aid teaching: better preparation of the pupils concerning general difficulties faced at the scene of an accident; presentation in succinct form of essentials for care of each accident type, with emphasis thereon rather than on details; provision in the home and automobile of splints and bandage material of adequate size for coping with major accidents.

In preparing the first aid course, it is necessary to plan for the entire course rather than for the isolated lecture. The subject-matter we want to teach must be specifically defined; then such subject-matter objectives must be weighed against the pupils' abilities to learn in the allotted time. One cannot teach nearly everything one may want to teach; the subject-matter must be ruthlessly slashed perhaps, for only the most important can be considered. But the total usable learning is increased through the indelible imprinting of the essential. These most important facets should be presented in brief form with crystal clarity; they should be emphasized again and again. Before a class, the instructor should have in mind the things he expects to emphasize specifically; thus 'To-day I will clinch the idea that accident victims must be carefully examined', or 'To-day, in considering first aid for concussion, I am going to drive home the idea that victims must be kept quiet'. The instructor will keep to his outline and to his sequence and not be diverted into a morass of side aspects. The physician knows so much, he has had so many interesting experiences, that it becomes easy for him to overflow the banks of the essentials. Eliminating consideration of aspects fairly but not essentially important is like pulling teeth; but it must be done often in first aid teaching for the lay public if the heart of the topic is to be presented emphatically.

In preparing the pupils for the scene of the accident it is important that they visualize the difficulties and common mistakes of the first aider. The lecture which treats of this topic and imparts general rules applicable in any accident is no doubt the most important one in the entire course.

To appreciate the difficulty of preparing an effective lecture on this topic, one which will in the dim future result in a good first aid job, one need only reflect on the teaching task. Ordinarily the students in the course are not conditioned to sweat in study. They expect the facts to come in gently. Yet it is the teacher's responsibility to face the teaching situation. The course is usually of only twenty hours, and there is much ground to be covered. Much of the time must be spent in doing first aid practice procedures, so that only part of the time can be devoted to lectures. Yet, despite possible deficiencies of the pupil in ability, motivation and time, this pupil must remember—if the teaching is to be effective—material for an accident, which may not occur for many years. There are many kinds of accidents, but the student must remember what to do for the one which, unheralded, occurs. Meanwhile he has seldom had time for review.

Then, when the accident occurs, this pupil is in a new situation, a dramatic one perhaps. He does not

have an opportunity at this time to sit down and cogitate about the whole matter in peace and quiet. He may be deluged by the enormity of the harm, by the presence of death, by the onlookers, hysterical relatives, injured victims, importunate bystanders. Necessary apparatus, prepared or improvised, may be difficult to obtain. Zero weather, heavy rainfall or concomitant traffic may in effect represent forces which nullify all the teaching. And so he may regard the accident he meets as different from any studied or, while knowing what is correct procedure, surrender to the exigencies of the occasion and give poor first aid.

Attention may then well be directed at the following:—

1. Every accident seems different, unique. The general rules should be followed unless one is positive that modification is indicated. The student who knows the common mistakes of the first aider is fortified against making them himself.

2. A careful examination is very important. The first aider is strongly tempted to give only a superficial examination, to hurry through it. A good examination requires deliberation, time, tact.

3. In the presence of serious injuries, other injuries should be searched for and, if present, treated with care.

4. There is tremendous pressure, at the time of a serious accident, that something be done. Doing nothing other than keeping the victim quiet and warm for the time being is often the indicated procedure, but such action is most difficult. The victim and the onlookers interpret this deliberation as a sign that the first aider does not know what to do. Physicians, police and firemen in first aid work subscribe to the statement that this great importunity exists at the scene of the accident.

5. Advice from bystanders is often confusing, occasionally commanding. The first aider, recalling only tenuously what is right, may easily be swayed by others.

6. The drunken are usually hard to handle when injured; they are especially likely to be hysterical, often claim to be hurt far worse than they really are. Yet drunkards are often involved in accidents, may be seriously injured; hence the first aider can take no chances and must be persistent in his examination. Some people seem to feel that a drunkard has forfeited the right to receive good first aid.

7. Very often it is wise to call a physician to the accident scene. Permission of the victim or of a responsible person should first be secured, if possible. In all serious accidents, the first aider should consider carefully this possibility of getting a physician to the scene of the accident.

Students occasionally do not learn clearly some of the first aid procedures. In the flood of details presented to them, they do not see the principles of care. The instructor should think of (1) imparting the facts and (2) having the students bring the facts back to him. Thus they learn better, for they must do the stating and must participate; they secure repetition through the process and learn of their own deficiencies. The instructor learns of their misconceptions and finds where his teaching has fallen short. The Red Cross textbook has more than 250 pages; the material in it will not be uniformly well remembered through the years. If the teacher considers carefully every paragraph, he will not gain emphasis; he will fail to impress the essentials indelibly. It is easy to get far too much detail, to lose perspective view. The teaching should conform to the practical situation and the teacher bear in mind the weighting of topics and be guided by subject-matter, pupils, objectives.

Let us take the case of fracture care. There are more than two hundred bones in the body. One cannot reasonably expect that students will remember through the years the ideal splint for each type of fracture considered in the textbook. Yet teachers occasionally spend time to no real purpose on requiring the memorization of such terms as femur, humerus and vertebra. The student should understand thoroughly the idea in splinting: to keep the broken ends quiet.

He should understand thoroughly the treatment of shock and the factors that increase shock. For emphasis the following suggestions may be stressed:—

1. Don't let the broken ends move.
2. Treat shock.
3. Treat every possible fracture as a fracture.

A general rule for splinting is that the splints should extend well beyond the joints adjacent to the fracture. For purposes of lay education, one may state that by and large a splint can hardly be too long except it becomes unwieldy. A heavy splint, poorly attached, may contribute more to shock than a light one so placed. Students should have considerable practice in applying splints so that they learn to organize, prepare and expedite their efforts and to apply them well. They must learn how to transport a victim a few feet, if such is necessary in order, for instance, to escape traffic. They must get practical help concerning improvisations. Too often recommendations are impractical to the scene of the accident. The first aider may find that raw material for improvisations may not be as easy to find as he had thought, for he may encounter his accident in heavy rainfall, darkness or bitterly cold weather. Under these circumstances, if he spends time looking for fallen boughs, fence posts, or random boards, the victim may sink into deep shock. It is exceedingly important that the teaching recommendations foresee the practical situation.

I have used the accompanying diagrams in summarizing where splints should be placed and I ask students to repeat the drawings after they study the textbook.

The students are commonly surprised that the learning on this aspect becomes easy through the method used. Concerning back injuries, the students should know the implications of spinal cord injury; they should know of the insidiousness, as far as history, symptoms and signs are concerned, of this type of injury. Certainly first aid for fractures of the neck should be rendered by a physician called to the scene of the accident.

Head injuries and cerebral circulatory accidents are often encountered. Almost 50 per cent of fatal traffic accidents show concussion as the cause of death, according to National Safety Council reports. Whether concussion or stroke, the victim should be kept quiet. The care may be outlined as follows:—

1. Keep the victim quiet.
2. Elevate his head somewhat if the face is red; keep it level if the face is pale.
3. Give the victim no stimulants.
4. Apply an ice cap, if available, to the head.

It is important to consider drunkenness in connection with head injuries. Often the drunkard is the victim of an accident and the injury is dismissed. The textbook discussion on this point is good.

Criticism has repeatedly been directed against various aspects of teaching on the topic of artificial respiration. Many misconceptions concerning theory are held. Henderson and Turner, in a recent issue of *The Journal*, consider physiology and methods, their article being based on much research work. This article should be read by all first aid instructors. Many instructors insist on meticulous observation of minor points in administering artificial respiration. Clearly, the following points should be emphasized:—

1. Get started at once.
2. Compress the chest and release twelve to fifteen times a minute.
3. Treat shock.
4. Keep the victim quiet after he starts breathing.

The student should know of the precious time interval between cessation of breathing and cessation of heart action. He should therefore know of the great need for starting artificial respiration at once. Though the prone pressure method is used ordinarily, it is occasionally impossible to straddle the victim. The student should understand the idea so that he will start artificial respiration in a boat or wherever he finds the victim.

The student should know when the method is useful. Occasionally instructors state that the

procedure should be followed any time a victim is not breathing. Hence first aiders are giving artificial respiration to victims of stroke, of concussion and even of infectious disease. The argument favouring such teaching is as follows: If a victim is not breathing, artificial respiration cannot be harmful, though it may be useless. One cannot expect the average person to remember a series of indications for its use; but if this person is taught to use the method any time a victim is not breathing, he will remember such a simple rule well.

The argument fails to consider the commonest mistake of the first aider. In his excitement he administers the prone pressure method to victims who are unconscious but breathing. Such cases often represent stroke, concussion or injury to the visceral system. The procedure of artificial respiration here may represent the finishing coup; it is definitely dangerous. During the past year I have seen two cases in which prone pressure method was being used on victims of stroke. These injuries are very common, and if the first aider gives artificial respiration to every victim of stroke or concussion he sees he may be responsible for more dire results than the good which follows use of the method wisely. Hence students must learn when artificial respiration is to be used.

The technique of the prone pressure method requires practice for good administration. The beginning instructor should be coached in the technique by an experienced operator. Otherwise, while he may get a good exchange of air, he may fail as a teacher in being awkward or singularly atypical in method.

In consideration of shock, the important thing is the prevention and the treatment. One may require the students to memorize thoroughly the symptoms and signs. Time devoted to one facet is obtained at the expense of time devoted elsewhere. Aside from modification of treatment with certain injuries, such as concussion and heat stroke, all accident victims should be treated through (1) heat, (2) position, (3) stimulants. The revised edition of the Red Cross textbook presents in improved fashion the first aid handling of burns. Perhaps one may look forward to better work on the part of graduates of the course in this type of accident.

The preceding paragraphs indicate the method of analysing the subject-matter in order to emphasize the heart of the topic, in order to gain emphasis. The main points should be clinched.

In order to apply methods learned, the first aider must have materials at the scene of the accident. Observation shows that in a proportion of cases graduates do not improvise material. The difficulties they feel are overbalanced by other factors. First aid kits provide a partial answer, but they are inadequate when the accident is a major one. They ought to be in each home and each automobile. But there should also be available in each automobile a few splints, at least six large triangular bandages, a flashlight and a jack knife. These can readily be provided and carried; certainly they can be provided more easily before than at the accident. If they are present, they will likely be used. If not present, the likelihood of transfer of the patient without splinting is greater. A film, sponsored by many medical societies and dealing with fracture care, has been widely shown to the public. This film demonstrates only the Thomas splint. But how often is the Thomas splint available at the scene of the accident? The real situation has again not been visualized. How may the situation be remedied? The answer is very simple: Have the pupils while enrolled in the course prepare the material for their own cars and homes. They can cut notches in the splints in such manner that traction splinting is possible. By teaching first aid, the teacher acknowledges its importance; he therefore is consistent when he insures application through providing necessary materials.

After the text work has been completed, a valuable teaching technique is to present hypothetical accident situations to the class, letting it work out procedures on designated victims. The pupils thus learn well the difficulties and factors to consider and also to organize

their efforts. Even medical students, segregated into groups of two or three, find difficulty in planning first aid procedures for such a simple matter as splinting an ankle.

Films ought to represent an exceptionally valuable teaching aid. From them students might visualize well the scene of the accident, the discouraging aspects for good first aid, the difficulty of going ahead in a planned way and the common mistakes made. Unfortunately,

available films omit particularly the aspects one would like to see. Sometimes significant omissions occur. Thus a film which suggests use of iodine on cuts ought to present some cautions when the lay public is being taught. Surgeons, when previewing films, commonly raise valid objections. However, better films will doubtless be prepared. The makers should have knowledge of the actual accident situation and experience in teaching first aid.

## Reviews

**TEXTBOOK OF MEDICAL TREATMENT.**—By Various Authors. Edited by D. M. Dunlop, B.A. (Oxon.), M.D., F.R.C.P. (Edin.), L. S. P. Davidson, B.A. (Camb.), M.D., F.R.C.P. (Edin.), F.R.C.P. (Lond.), and J. W. McNee, D.S.O., D.Sc., M.D. (Glas.), F.R.C.P. (Lond.). Second Edition. 1942. E. and S. Livingstone, Edinburgh. Pp. xxiv plus 1179. Price, 25s.; postage, 9d.

It does not seem very long ago that the reviewer received the first edition of this book for review. Since then he has used it as a reference book and has seldom found it wanting. In the second edition, there has been a certain amount of addition in all the sections, but it does not in any way alter the character of the book. Many minor defects have also been remedied. The sections referring to tropical diseases are probably the best that have ever appeared in a book on general medicine. The accounts given of the treatment of sprue, cholera and dysenteries are excellent. The same can be said about the section on malaria which gives the names of all the more up-to-date synthetic substitutes for the German antimalarial drugs which were mentioned in the previous edition.

We had one or two criticisms to make on the first edition and there are still some that are applicable to this edition. Col. Gregg still remains loyal to his old colleague, and places thymol first as an anti-helminthic in the treatment of ancylostomiasis. It is quite true that some past helminthologists who had had vast experience recommended this drug, but time has moved on and I know no practising helminthologist of any reputation who would recommend its use now, except as an experiment to convince the die-hards. Loyalty to his country has also made this writer omit the most valuable antimony drug that has ever been used in the treatment of kala-azar, namely neostibosan; he has replaced it by anthiomaline, a drug which has been used in some half a dozen cases with apparently very indifferent results, but is marketed by a British firm. He has also mentioned the new drug, diamidino stilbene. His directions for dosage are not however very helpful. The total dosage which he recommends is 360 mgm. which is totally inadequate for an adult and the dose is recommended for a child in the publication from which he has obviously obtained this figure.

The student, and for that matter the practitioner, can purchase this book with confidence that he is getting almost the best possible value for his money.

**A MONOGRAPH ON ADOLESCENT SPONDYLITIS OR ANKYLOSING SPONDYLITIS: THE EARLY DIAGNOSIS AND ITS TREATMENT BY WIDE-FIELD X-RAY IRRADIATION.**—By S. Gilbert Scott, M.R.C.S., L.R.C.P., F.F.R., D.M.R.E. (Camb.). 1942. Oxford University Press, London. Humphrey Milford. Pp. xiv plus 132. Illustrated. Price, 5s. Obtainable from Oxford University Press, Bombay and Calcutta

HERE is an important work which should be read by all practitioners. It would appear from the author's investigation that what has hitherto been looked upon as an incurable and crippling disease can now be diagnosed in its early stages, provided the rule is observed that 'all patients under 25 years of age with

rheumatic symptoms should be referred to the x-ray department for an examination of the sacro-iliac joints'. If the patient is then submitted to the recommended form of treatment by 'wide-field x-ray therapy' there is nearly a 100 per cent chance of cure. Even in the more advanced stages of the disease some palliative effect is to be expected from this form of treatment.

The pathology of adolescent spondylitis needs further investigation as does the possibility of using wide-field x-ray therapy in other diseases where its principle of having 'a remarkable stimulating or constitutional influence on the whole body, the final result being a raising of the general resistance' whereby the patient is placed 'in a position to cure himself, irrespective of the disease from which he is suffering'.

This is an Oxford medical publication of 132 pages. While realizing the author's endeavour to stress the importance of his work one feels that the subject-matter could well have been reduced—thereby saving much repetition and paper. The book is well set up and the radiographic plates are excellent.

G. C. T.

**THE AUTONOMIC NERVOUS SYSTEM: ANATOMY, PHYSIOLOGY AND SURGICAL APPLICATION.**—By James C. White, M.D., and Reginald H. Smithwick, M.D. Second Edition. 1942. Henry Kimpton, London. Pp. xx plus 469. Illustrated. Price, 35s.

IN this book, the authors have succeeded in presenting a readable account of surgery applied to the autonomic nervous system as it stands to-day. Fact and theory regarding the subject are collected here in an orderly way and are critically reviewed in the light of the authors' extensive experience at the Massachusetts General Hospital. Professor Cannon and others of the Harvard School have been called on to collaborate in part I which deals with physiology and anatomy. Part II discusses the ways in which it is possible to modify abnormal activity of smooth muscle and glands by interference with their autonomic nerves. The conditions are indicated in which it is now known that sympathectomy is of value and those in which it is definitely not.

It is a pity that the authors confessedly did not make any special effort to discuss diagnosis and one feels that the 'medical' aspects could have been given more attention with advantage. The operative treatment, however, of hypertension is well done and one learns that 'significant effect has followed thoracico-lumbar sympathectomy in 65 per cent of cases in a short series of cases followed up for two years'. Part III describes details of operative technique. The illustrations make the points intended but the judicious use of colour would have improved them. This section is as good as one would expect from men who have done much to advance the subject. A large number of references are supplied up to and including part of 1941. One need look no further for a good up-to-date account of the autonomic nervous system for here it is predigested, palatable and easily assimilable.

E. D. M.

**ACUTE INJURIES OF THE HEAD: THEIR DIAGNOSIS, TREATMENT, COMPLICATIONS AND SEQUELS.**—By G. F. Rowbotham, B.Sc. (Manch.), F.R.C.S. (Eng.). 1942. E. and S. Livingstone, Edinburgh. Pp. xii plus 288, with 124 illustrations, 12 in full colour. Price, 25s.; postage, 7d.

In the space of under three hundred pages this book deals with a subject which at present is of extreme importance to all surgeons. Many will have felt the need of a handy textbook by a good man describing the essentials in the diagnosis and treatment of acute head injury in a clear and practical fashion. The author wrote this book primarily for those faced with acute cerebral trauma who had not had a special training in neurology or neurosurgery and he has been extremely successful in this object.

Every aspect is adequately described. Chapter 3 on the diagnosis and chapter 4 on the treatment of closed head injuries are right up-to-date and beyond criticism. The sequels of injuries of the head are well done in chapter 7 and it would be well if all young physicians and surgeons were to read this section as it is an excellent summary of conditions which are and will be so common in this war and afterwards. The author also shows considerable understanding of the problems in psychiatry, psychoneurosis and malingering associated with these cases.

The author tells us that the script was submitted to Dr. F. M. R. Walshe and Mr. Norman Dott. No doubt the helpful advice, acknowledged in the preface, of these men in the top flight of neurology and neurosurgery has been of value in producing a book which is of first class value in raising the general standard of treatment of these cases.

G. C. T.

**THE ART OF LOVE AND SANE SEX LIVING (BASED ON ANCIENT PRECEPTS AND MODERN TEACHINGS).**—By A. P. Pillay, O.B.E., M.B., B.S. D. B. Taraporevala Sons and Company, Bombay. Pp. xxiv plus 530, with 80 illustrations and 92 photographs (81 photos, specially taken for this book by Dr. S. H. Marathe, M.B., B.S.). Price, Rs. 10

This is notoriously a difficult chapter for any author to open, that upon sex relationships, marriage and marital relationships, and it may be said that Dr. Pillay is the first Indian author to offer so comprehensive a work to the 'educated layman' for whom, in the preface, it is stated that the book is designed.

The text covers a very wide field including the anatomy and physiology of the sex organs, disorders

of menstruation and pregnancy, sterility and control of conception. This last-mentioned subject is one of the best treated in the book and for those who are interested in it, the book is well worth buying on that account alone.

Chapter XII, which deals with the legal aspects of marriage and sex, offers new material of great interest to the Indian family, as also does the chapter on physical exercise for men and women which is illustrated by photographs.

Throughout, the book is clearly prepared for the Indian reader; there are profuse quotations from Sanskrit and Persian writings, as well as from modern authors such as Havelock Ellis, Freud and Dickinson.

The author states that, among his friends, opinion was divided upon whether the treatment of some aspects was not too frank. Perhaps the omission of chapter XI, which deals with the deviations of the normal sexual instinct much in the manner of German authors, would not have affected the book adversely.

L. G.

**ILLUSTRATIONS OF BANDAGING AND FIRST-AID.**—Compiled by Lois Oakes, S.R.N., D.N. (Leeds and London). Second Edition. 1942. E. and S. Livingstone, Edinburgh. Pp. vii plus 256. Illustrated with 300 photographs. Price—De Luxe Edition, 6s.; Cheap Papered Edition, 4s. 6d.; postage, 6d.

This book provides an easily comprehended and accurate guide to bandaging for both the 'first-aid' and the hospital worker. The practical photographs are supported by simple notes which are sufficient in themselves to render the intelligent learner proficient, even in the absence of a demonstrator.

D. E. C.

**HANDBOOK OF HYGIENE FOR STUDENTS AND PRACTITIONERS OF MEDICINE.**—By Joseph W. Bigger, M.D., Sc.D., F.R.C.P.I., M.R.C.P. (Lond.), D.P.H., M.R.I.A. Second Edition. 1941. Baillière, Tindall and Cox, London. Pp. xii plus 414 with 18 illustrations including one plate. Price, 12s. 6d.

This handbook provides in a small compass much useful and up-to-date information on hygiene and is very well written. It will be read with profit not only by the ordinary medical student but will also supply useful information to those who are specializing in public health. A second edition in four years shows that it has gained popularity which it certainly deserves.

A. K. S.

## Abstracts from Reports

### ANNUAL REPORT OF THE CHEMICAL EXAMINER TO GOVERNMENT, UNITED PROVINCES AND CENTRAL PROVINCES, FOR THE YEAR 1941

The total number of cases examined during the year was 3,793 comprising 8,574 exhibits as compared with 3,569 cases consisting of 8,607 articles during the preceding year.

One thousand, four hundred and thirty medico-legal cases and 5,079 articles were examined during the year under report as against 1,514 cases and 5,510 articles in 1940.

The total number of cases of human poisoning examined was 316. Poison was detected in 70.2 per cent of cases as against 68.4 per cent in 1940. Dhatura was again the most commonly used poison. It was detected in 33.5 per cent of the detected cases.

In 2.6 per cent of cases, unidentifiable organic poisons were found. This shows the need for research on the indigenous vegetable poisons.

Bones and ashes of 2 persons were received and examined during the year. Arsenic was found in one of the cases.

Twenty-three cases of animal poisoning were examined as compared with 22 cases for the preceding year. The percentage of detection in these cases was 69.6. Arsenic was detected in 11 of the cases.

One thousand and ninety-one stain cases were examined under this section comprising 822 cases of blood stains and 269 cases of blood and semen stains. The percentage of detection in blood stain cases (murder or hurt by violence) was 96.5 as compared with 96.6 for the year 1940. Spermatozoa were detected in 92.2 per cent of cases of sexual offences as against 89.3 for 1940.

Five hundred and fifty-two samples of opium were received in connection with illicit traffic. Of these samples 394 were found to be contraband or adulterated. In addition to the usual examinations, all the samples of opium had to be assayed for prosecution purposes under the Excise Act.

## ANNUAL REPORT OF THE PREMANANDA FREE CHARITABLE OUTDOOR LEPRO DIS-PENSARIES FOR THE YEAR 1941

The year 1941 has seen certain important changes in the personnel of the committee of management and the medical staff.

The war has affected our work in various ways. It has increased the working expenses owing to the enhanced cost of essential drugs and other medical material and apparatus.

Another result of war conditions is seen in the falling off of the number of patients attending the Manicktola dispensary during the latter part of the year, amounting to about 50 per cent, though at the time of writing the numbers are showing a tendency to rise.

In addition to the regular medical work of the dispensaries we have been able to co-operate with the School of Tropical Medicine in making a full investigation of some hundreds of cases as a preliminary to preparing a case for the establishment of a Home or Colony to serve the needs of Calcutta, with which to approach Government, the Corporation, and the public generally in order to procure the necessary funds required to bring into existence an institution comparable to the Lady Willingdon Leper Settlement at Chingleput, Madras. Without this it is impossible to deal at all adequately with this very urgent problem.

Our work in the Kalighat district is still hampered by the lack of a suitable building but we have some hope of a suitable site being made available before long through the generosity of a landowner in that neighbourhood.

The total number of patients who attended for treatment during the year 1941 was 1,912 at Manicktola, and 676 at Kalighat. Last year's figures were 1,888 at Manicktola and 613 at Kalighat. Altogether they put in 41,047 attendances at Manicktola and 15,969 at Kalighat totalling 57,016. They received the following treatment: 37,204 anti-leprosy injections, 3,848 general treatment at Manicktola and 14,194 and 1,775 respectively at Kalighat. The average daily attendances were 162.8 at Manicktola and 105 at Kalighat.

Of these patients, 1,234 at Manicktola and 487 at Kalighat attended sufficiently regularly to justify re-examination at the end of the year. The following results were obtained:—

|                          | Manicktola | Kalighat |
|--------------------------|------------|----------|
| Disease arrested ..      | 59         | 41       |
| Much improved ..         | 351        | 155      |
| Slightly improved ..     | 414        | 195      |
| Same, as on admission .. | 410        | 96       |

One member of our staff regularly visits the homes of patients who have discontinued their treatment at their own discretion. His duty is to persuade them to return to our clinics for treatment, to explain the serious nature of the disease and to advise them about the precautionary measures to be taken against the spread of the disease in the family. Altogether 391 homes were visited; 59 cases only came back for treatment and 36 cases gave wrong addresses, so afraid are they of being known to be lepers. During these visits 5 contact cases were found.

## REPORT ON THE ADMINISTRATION OF THE EXCISE DEPARTMENT IN THE PRESIDENCY OF BENGAL FOR THE YEAR 1940-41

The total consumption of country spirit in the province was 717,129 L.P. gallons as compared with 661,650 L.P. gallons in the preceding year. There was a general increase in the consumption of country spirit throughout the province, excepting the district of

Bogra which showed a slight decline in consumption. The most noticeable instance of increase in consumption occurred in the district of Calcutta.

The total quantities of potable foreign liquor sold to the public in Bengal by licensed dealers were 147,391 gallons of spirits, 16,849 gallons of wines and 687,608 gallons of beer. This does not include medicated wines.

The total quantity of ganja consumed in the province during the year of report was 905 maunds 7 seers against 866 maunds 31 seers in the preceding year showing a net increase of 38 maunds 16 seers or 4.4 per cent. During the year 1,120 seers were sent to French Chandernagore as against 1,470 seers in 1939-40.

Three maunds 11 seers of ganja were issued at the concession rate of duty of Rs. 15 per seer for the manufacture of medicinal preparations by chemists against 2 maunds 5 seers in the previous year.

The demand for bhang was mostly confined to the West Bengal districts. In some of the districts in East and North Bengal, bhang grows wild. It is suspected that the major portion of consumption of bhang that exists in those districts is met from the illicit drug of wild growth. There has been a considerable decline in the use of bhang by village kabirajes. The total quantity of bhang consumed in the presidency amounted to 229 maunds 15 seers against 222 maunds 38 seers in the previous year, showing an increase of 6 maunds 17 seers or 2.8 per cent.

The total quantity of charas imported by the wholesale dealers at Birbhum and Calcutta was 21 maunds 38 seers 1 chittak against 21 maunds 1 seer 13 chittaks in the previous year, showing an increase of 36 seers 4 chittaks. The actual consumption in Calcutta amounted to 15 maunds 33 seers against 14 maunds 15 seers in the previous year, showing an increase of 1 maund 18 seers.

The consumption of excise opium during the year under report was 670 maunds 5 seers as compared with 655 maunds 28 seers of the previous year showing an increase of 14 maunds 17 seers or 2 per cent. There was general increase in the consumption of opium throughout the province except in certain parts where there was distress. Noticeable increase in consumption occurred in Calcutta, Midnapore and Bakarganj. The increase in consumption in Calcutta was chiefly due to the prevention of smuggling of opium from outside the province as a result of detection of some very important cases of opium smuggling which broke up some organized gangs of smugglers of considerable inter-provincial notoriety. Stricter control of the licensed shops also to some extent accounted for the increase in the licit sale of the drug.

The manufacturing chemists of Calcutta imported from Ghazipur opium factory 1,000 pounds of opium powder and 50 pounds of opium in cake and 72 pounds 11 ounces of morphia hydrochloride. The import of opium powder showed an increase of 647 pounds and that in cake showed a decrease of 25 pounds in comparison with the last year's figures.

There was no evidence of the use of cocaine as an intoxicant and the habit was unknown in almost all the districts except that its existence in a limited extent was reported from the districts of Calcutta and Dacca and in the mill areas of the 24-Parganas.

Four ounces of confiscated cocaine which were in stock and certified to be fit for use by the chemical examiner, were issued to the charitable dispensaries during the year under report.

## JUVENILE JAIL, BAREILLY: CORRECTIONAL AND REHABILITATION WORK (1939, 1940 AND 1941). BY LIEUT.-COLONEL A. H. SHAIKH, I.M.S., INSPECTOR-GENERAL OF PRISONS, UNITED PROVINCES

Annual report.—This jail receives convicted juveniles from the other jails. There are no direct admissions from the courts.

Our general correctional programme came into existence on 1st January, 1939. On admission we give

affection and considerate treatment to our boys as much as it is expected in a well adjusted home.

After the boy gets settled down and feels at home, we try to get him interested in games and scouting.

After the games, we get him interested in work such as tailoring, carpentry, etc.

He is given the work of his choice. If he does not like to take up any of the outlets we have, his aptitude is studied and interest created for one of the outlets we have in the jail.

Lastly we get him interested in studies. There we do not find so much keenness as for the games and the work.

Out of the population of 182 boys we found 8 incapable of being educated and 10 required extra time and special attention to get through their texts. This gives a total of 18 retarded and defectives out of 182 which comes to almost 10 per cent.

As an aid to our correctional programme, we introduced the experiment of granting leave to the desirous and deserving inmates of this jail, in order to enable them to go home and spend a few days with their parents and other relations.

The experiment covers a period of two years and three months. During this period 36 boys have been on home leave. They all returned punctually to the jail at the expiry of their leave. There was no escape nor even an overstayal.

The present system of *rehabilitation* started on 1st June, 1939, and covers a period of two years and a half. The object is to inculcate in the youngsters a sense of social responsibility and a habit of work, and to enable them to equip themselves for an honest and decent living upon leaving the prison. The method consists in apprenticing the young offenders, while

serving the sentence, in a factory or an institution or under an employer of labour. When at work, there is no surveillance by the jail and the offender works side by side with the free labourer; goes there on his own, and returns to the jail in the evening after the day's work is over. The wages he earns are credited to him after making necessary deduction for food, etc.

#### *A note on sex deviation*

*Review.*—This report records that enquiries indicate that 30 per cent of the male population in a certain district have indulged at one time or another in homosexual practices, but the number of police arrests and convictions is only a few every year.

The author describes the phase of homosexual feeling through which most persons pass before puberty, and attributes the high incidence of homosexual practices to the lack of free association of the sexes.

In spite of the fact that persons guilty of such offences were not eligible for admission, examination of the inmates of the juvenile jail in 1939 revealed that 22 per cent had played a passive rôle in such practices. The number playing an active rôle was not known.

With the rehabilitation work the proportion of passive agents fell in 1940 to 11.5 per cent and in 1941 to 7 per cent. The chief changes instituted were the full occupation of the inmates from 5 a.m. to 9 p.m. and the removal of control exercised by boys over other boys, all authority being vested in the staff.

The author emphasizes the rarity of any serious results of masturbation, and also the fact that these results are produced by shame and fear rather than by the act itself.

## Service Notes

### APPOINTMENTS AND TRANSFERS

THE VICEROY AND GOVERNOR-GENERAL has been pleased to make the following appointments on His Excellency's personal staff with effect from the dates stated :—

#### *To be Honorary Surgeon*

Colonel W. C. Spackman, *vice* Colonel H. E. Shortt, C.I.E., vacated, 23rd August, 1941.

On re-employment Colonel J. J. Harper Nelson, O.B.E., C.I.E., M.C., I.M.S. (Retd.), assumed charge of the office of Civil Surgeon, Lahore, on the 16th July, 1942.

Brevet-Colonel Sir R. N. Chopra, C.I.E., I.M.S. (Retd.), is appointed Emeritus Professor in the School of Tropical Medicine, Calcutta.

Major H. S. Waters, Professor of Midwifery and Gynaecology, Grant Medical College, and Specialist in Obstetrics with Gynaecology, Bai Motlibai and Sir D. M. Petit Hospitals, Bombay, is appointed to officiate as Superintendent, St. George's Hospital, Bombay, *vice* Lieutenant-Colonel S. R. Prall, granted leave.

Major W. S. Morgan, Agency Surgeon in Bundelkhand, resumed charge of his duties, with effect from the forenoon of the 14th July, 1942.

On transfer from Lahore Major G. J. Joyce assumed charge of the office of Civil Surgeon, Amritsar, on the 20th July, 1942.

The undermentioned officers (on probation) are confirmed in the Indian Medical Service, with effect from the dates specified, subject to His Majesty's approval :—

#### INDIAN MEDICAL SERVICE (Permanent Commissions)

##### *Majors*

P. P. Chowdry. Dated 22nd November, 1936.  
A. H. O'Malley. Dated 28th December, 1936.

### *Captains*

E. C. Hicks. Dated 23rd April, 1935.  
M. N. Mahmood. Dated 5th November, 1936.  
W. S. Davidson. Dated 1st January, 1938.

23rd April, 1935

I. J. Franklen-Evans. J. Duffy.  
J. F. A. Forster.

1st November, 1935

D. J. P. Parker. T. C. McM. Morrison.

27th December, 1935

W. McN. Niblock. T. P. Mulcahy.  
H. J. Gibson. P. A. Hubbard.  
F. E. McLaughlin.

S. W. Allinson. Dated 13th January, 1936.

23rd April, 1935

A. W. Sampey. C. L. Greening.  
J. Reidy. C. B. Jones.  
G. F. Adye-Curran.

G. R. C. Palmer. Dated 17th December, 1934.  
J. Revans. Dated 24th June, 1935.  
T. Sommerville. Dated 1st November, 1935.

1st May, 1936

A. C. Taylor. J. G. Thomson.  
R. J. Henderson. Dated 24th June, 1935.  
C. W. A. Searle. Dated 26th June, 1935.  
L. M. Kelly. Dated 1st May, 1936.  
J. H. Caverhill. Dated 27th June, 1937.

1st September, 1936

S. C. Colbeck. W. S. Empey.  
J. H. Bowie. A. G. Miller.



31st October, 1936

M. C. L. Smith. B. M. Wheeler.

1st November, 1935

V. D. Gordon. D. R. Nicol.  
B. deBurs. J. Morgan.

C. H. Bliss. Dated 31st October, 1936.

1st May, 1937

S. Shone. J. H. Walters.  
E. H. Wallace. Dated 27th December, 1935.

28th December, 1936

J. D. O'Shaughnessy. D. R. Cattnach.  
J. E. O'Donnell.

W. J. Young. Dated 1st February, 1936.

J. L. Mewton. Dated 31st August, 1937.

J. F. Thomson. Dated 1st September, 1936.

1st May, 1936

L. S. F. Woodhead. J. R. Kerr.  
J. D. Munroe. Dated 31st October, 1936.

1st May, 1937

W. C. Templeton. G. W. Palmer.  
B. J. Doran. Dated 31st October, 1936.  
T. M. Williams. Dated 1st November, 1937.  
R. B. Davis. Dated 31st October, 1936.  
W. M. Wilson. Dated 1st January, 1938.  
W. A. Hopkins. Dated 1st September, 1936.  
J. W. R. Sarkies. Dated 1st May, 1937.

31st August, 1937

L. U. Kamm. T. Denness.  
F. MacD. Byrn. Dated 31st October, 1936.  
W. Laurie. Dated 13th May, 1938.  
G. F. J. Thomas. Dated 1st May, 1937.  
J. H. Cater. Dated 31st October, 1936.  
R. D. Ewing. Dated 1st November, 1937.  
G. B. Jackson. Dated 31st August, 1937.  
G. W. Greene. Dated 1st November, 1937.

1st January, 1938

W. L. Fennell. T. A. Cunningham.  
D. R. Hanbury.  
R. Passmore. Dated 2nd March, 1938.  
T. P. Binns. Dated 1st November, 1937.

1st May, 1937

R. Y. Taylor. W. H. A. Thorne.  
W. W. Coppinger. Dated 1st November, 1937.  
F. C. Griggs. Dated 1st January, 1938.  
G. A. Graham. Dated 1st November, 1937.

1st January, 1938

D. McC. Black. J. G. Fife.

1st May, 1938

N. D. Jekyll. A. R. Woodforde.  
A. C. Glendinning. Dated 31st August, 1937.  
R. D. D. Birdwood. Dated 1st November, 1937.  
J. W. Lillico. Dated 1st January, 1938.

Captain (Acting Lieutenant-Colonel) B. K. Sheorey, Deputy Assistant Director-General, Indian Medical Service (A.R.P.), is appointed Assistant Director-General, Indian Medical Service (A.R.P.), with effect from the 4th April, 1942.

Captain R. K. Garde, Additional Officer, Medical Store Depot, Bombay, is appointed Deputy Assistant Director-General, Indian Medical Service (A.R.P.), with effect from the 12th May, 1942.

*(Permanent Commissions)*

The undermentioned Captains (on probation) are confirmed, with effect from the dates specified:—

R. D. Ayyar. Dated 5th November, 1936.

M. S. Zan. Dated 4th December, 1936.

## INDIAN LAND FORCES

*(Emergency Commissions)**To be Captains (on probation)*

William Arthur Chammugan Nason. Dated 24th August, 1941, with seniority from 18th April, 1939.

Manmohan Nath Khanna. Dated 9th October, 1941, with seniority from 9th October, 1933.

Amar Nath Malhotra. Dated 6th December, 1941, with seniority from 6th December, 1938.

Ram Mansoor. Dated 5th February, 1942, with seniority from 6th February, 1937.

## INDIAN LAND FORCES

*(Permanent Commissions)**To be Captains (on probation)*

12th July, 1942

P. N. Bardhan, with seniority in his present rank from 12th January, 1937, and in the rank of Lieutenant from 12th January, 1936.

B. Bhattachariya, with seniority in his present rank from 12th July, 1937, and in the rank of Lieutenant from 12th July, 1936.

H. N. Sen Gupta, with seniority from 12th July, 1938.

M. B. Menon, with seniority from 12th July, 1938.

G. H. K. Niazi, with seniority from 12th July, 1938.

*(Emergency Commissions)**To be Lieutenants*

Isabella Louise Hamilton Hewlett. Dated 29th May, 1942, with seniority from 27th November, 1935.

May Emma Maud Fleming. Dated 29th May, 1942, with seniority from 12th August, 1937.

Margaret Ellen Mary Blanden. Dated 29th May, 1942, with seniority from 11th February, 1940.

Charles Sonick. Dated 10th January, 1942, with seniority from 22nd September, 1941.

Michael Joseph Barry. Dated 21st February, 1942, with seniority from 2nd November, 1938.

John Alexander Walton Bingham. Dated 21st February, 1942, with seniority from 1st May, 1937.

George Richard Butterfield. Dated 21st February, 1942, with seniority from 7th August, 1936.

Cawlus Robert Kinsley Carroll. Dated 21st February, 1942, with seniority from 10th February, 1941.

Claud Conway. Dated 21st February, 1942, with seniority from 24th September, 1939.

Donald Currie. Dated 21st February, 1942, with seniority from 29th July, 1941.

Howell McIntyre Davies. Dated 21st February, 1942, with seniority from 19th June, 1941.

Alfred Charles Greene. Dated 21st February, 1942, with seniority from 25th November, 1939.

Francis Alleyne Hall. Dated 21st February, 1942, with seniority from 26th February, 1941.

Roger Clement Hallam. Dated 21st February, 1942, with seniority from 8th May, 1941.

George Hannigan. Dated 21st February, 1942, with seniority from 9th May, 1941.

Frederick Hunter. Dated 21st February, 1942, with seniority from 22nd August, 1935.

Nicholas Nikolaevich Iovetry-Tereshchenko. Dated 21st February, 1942, with seniority from 29th March, 1941.

Hugh Vernon Knight. Dated 21st February, 1942, with seniority from 21st February, 1936.

Alastair Delmi Archibald Maconochie. Dated 21st February, 1942, with seniority from 5th August, 1941.

John William Magner. Dated 21st February, 1942, with seniority from 22nd November, 1940.

John Michael Mungavin. Dated 21st February, 1942, with seniority from 11th December, 1940.

Brian John Niall. Dated 21st February, 1942, with seniority from 8th April, 1936.

Geoffrey Lewis Leslie Reynolds. Dated 21st February, 1942, with seniority from 18th June, 1940.

Louis Rich. Dated 21st February, 1942, with seniority from 2nd May, 1937.

John Lawton Roberts. Dated 21st February, 1942, with seniority from 14th June, 1941.  
 Basil Rowlett. Dated 21st February, 1942, with seniority from 4th May, 1941.  
 Charles Gordon Rennick Sell. Dated 21st February, 1942, with seniority from 4th August, 1941.  
 Stanley Ernest Vincent. Dated 21st February, 1942, with seniority from 8th June, 1941.  
 Gilbert Benjamin Rowland Walkey. Dated 21st February, 1942, with seniority from 27th March, 1941.

*To be Lieutenants (on probation)*

27th February, 1941.

Vishnu Narayan Khaana, with seniority from 27th February, 1940.  
 Framroze Jehangir Bilimoria, with seniority from 27th February, 1940.

(DENTAL BRANCH)

(Emergency Commissions)

*To be Lieutenants (on probation)*

Minocheker Kaikhosbru Sanjana. Dated 9th October, 1941.

Satya Pal. Dated 8th December, 1941.

5th May, 1942

George Mathias.  
 Lekh Raj Bhalla.  
 Nariman Rustomji Vazifdar.  
 Sorab Munchershaw Nicholson.  
 Mohan Dev Mehra.

6th May, 1942

Hari Dayal Gupta.  
 Keshab Chandra De.  
 Harish Chandra Aurora. Dated 7th May, 1942.  
 Parkash Chander Verman. Dated 5th March, 1942.  
 S. Bratt. Dated 6th March, 1942.  
 Hardasmal Jagatsing Kundanani. Dated 7th March, 1942.  
 Sunil Kumar Gupta. Dated 8th March, 1942.  
 Charles Mathew Rego. Dated 9th March, 1942.  
 Henry Joseph Lobo. Dated 10th March, 1942.  
 Gordhan Lal Narula. Dated 20th March, 1942.

*To be Lieutenant (on probation)*

Vasant Gopal Dabholkar. Dated 18th April, 1942.

Lieutenant Vasant Gopal Dobhalkar is seconded for service with the Royal Indian Navy, with effect from the 18th April, 1942.

LAND FORCES

*To be Lieutenant (on probation)*

Gordon Arthur Ransome. Dated 11th April, 1942.

(Emergency Commissions)

Albert Francis Lasrado. Dated 15th April, 1942.  
 Darashah Rustomji Bharucha. Dated 18th May, 1942.  
 Mohammed Abdul Sami. Dated 4th June, 1942.  
 Mohammad Ziz-Ullah. Dated 22nd June, 1942.

PROMOTIONS

Major F. R. W. K. Allen, Civil Surgeon, Raipur, has been promoted to the rank of 'Lieutenant-Colonel', with effect from 5th April, 1942.

*Captains to be Majors*

J. G. Stonham. Dated 1st February, 1942.

E. C. Hicks. Dated 7th June, 1942.

The undermentioned Captains are granted the local rank of Majors, whilst employed as Senior Medical Officers in Recruiting Areas, with effect from 18th February, 1942:—

B. R. Khinijo (A.I.R.O.).  
 H. R. Kapoor (A.I.R.O.).  
 Parduman Singh (A.I.R.O.).  
 A. L. Khurana (A.I.R.O.).  
 R. L. Soota.

S. K. Ghose (A.I.R.O.).  
 A. K. Mallick (E.C.).  
 K. C. Virmani (A.I.R.O.).  
 S. D. Butt (E.C.).  
 C. K. Patel (A.I.R.O.).  
 B. L. Sahi (A.I.R.O.).

PROMOTIONS

The following promotions are made:—

INDIAN LAND FORCES

(Emergency Commissions)

*Lieutenants to be Captains*

Sardar Ahmad, Charanjit Shah Singh, Shushil Kumar Puri, Bishambhar Nath Kapur, Jyoti Ranjan Sen Gupta, Suchil Mohan Dass, Kazi Abdul Jabbar, Prabandham Rangachar, Anil Prasanna Banerjee, Wunnava Venkata Bapaiah, Ali Akbar Shah, Manikkath Narayana Menon, Radha Raman Lal, Surendra Nath Chatterjee, Shiva Bhajan Prasad Tewari, Kali Shankar Bagchi, Kozhimannil Abraham, Jagdish Chandra Das Gupta, Rahatullah Khan, Govind Shamrad Vingle, Pratap Chand Badhwar, Madhab Chandra Bhattacharyya, Riaz-ud-Din Quraishy, Mukunda Seshagiri Prabh, Vaigalathur Sunderamier Ramaswami, Christopher Arumainayagam, Sita Ram Kaura, Nripendra Narayan, Nariman Kaikhosbru Shroff, Hirendra Mohan Gangopadhyaya, Velu Vaidyer Krishna Vaidyer, Amir Chand Narula, Mohammad Qasim Ali, Yashwant Dattatry Deshpande, Navroji Manekji Kalapesi, Thekevetil Ninan Chacko, John Pakiam, Gurmukh Das Agarwal, Gehi Wadhmal Keswani, Jitendra Chandra Chakrabarti, Abani Kumar Das Dastidar, Deva Prasad Ray, Sarat Chandra Srimani, Jiban Krishna Bose, Joseph Elmer Grieff Baker, Mahendra Vikram Singh, Chethalavada Sanjeevi Venkatasubramaniam, Velacheri Kuppaswami Sundaram, Bahadur Singh Nagra, Sri Krishna Suri, Jose Luciano Glennie Pinto, Mian Akbar Jan, Pundi Srinivasa Raghvan, Gurpur Damodar Shenoi, Chandulal Shirolal Tamboli, Palayathil Velandi Krishnan, Digambar Shivramsa Khatri, Nanabhai Framroze Lilauwala, Maduriah Chetti Muniswamy, Gajanan Dattatray Joglekar, Amulya Kumar Saba, Prabhas Kumar Sen, Ram Krishna Chettur, Ramamurti Arunachalam, Bisheshwar Dayal, Balkrishna Kesheo Sheorey, Bishamber Nath Baggan, Boddapati Amrit Rao, Hans Raj Nischol, Raman Sukumaran, Vasudeva Krishna Row, Ramesh Chandra Biswas, Jonnalagadda Surya Prakasa Rao, Brij Ballabh Parshad, Kundan Singh Gill, Jiban Krishna Sarkar, Gopal Ganesh Sahasrabudhe, Muddassir Khan, Rabindra Nath Sen, Shiv Dev Singh, Chhajju Ram Abrol, Gurditta Mal Diwan, Pargat Singh, Krishna Gopal Bhatia, Rustam Sohrab Tata, Nellorepalla Vankata Subrahmanyam, Revur Krishnamurti, Arumugam Pillai Thiagarajan, Cortielle Madhavan Nair, Itakhar Jahan, Balai Lal Roy Chowdhury, Anil Kumar Bose, Yeshwant Govind Joshi, Mayaram Venkatarama Ramachandran, Chambathil Ramanunni Mannadiar, Dady Framji Vachha, Mukhai Subramania Mahadevan, Palathiruthi Achutha Menon, Sardari Lal Bhandari, Pratibha Ranjan Dutt, Mohan Hatangdi, Gobinda Prasad Halder, Raghunath Singh Hoon, Mammen Mammen, Chirayath Francis Varied, Narayan Prasad Mahapatra, Guruswami Audikesavalu Naidu, Rishiyur Sundaram Thyaga Rajan, Phiroze Jehangirji Engineer, Panakkal Othuppu Ittooppunny, Thakar Das Narang, Sardari Lal Kalra, Bhag Singh, Vapa Purna Rao, Allen Arthur Rawat, Profulla Chandra Sen, Rai Sahib Lakshman Prasad Misra, Narayan Gangadhar Chitnis, Charu Bhavanishankar Bhargav, Vinay Bhavanishankar Bhargav, Fakir Chandra Mukherjee, Jal Harmajshaw Chibber, Gopal Laxman Chitale Bhajekar, Devki Nandan Mehta, Gursewak Singh Sidhu, Gauri Shankar Singh, Manmatha Nath Ghosh, Mafizuddin Talukdar, Lalgudi Annadurai Venkataraman, Balwant Singh Sachdev, Ashiq Hussain, Vadarangam Swaminadha Mahadevan, Jyotish Chandra Ghosh, Tattamagalum Subramanispattar Viswanathan, John John Eapen,

Abdul Kadeer, Madan Lal Madan, Tulsi Charan Bose, Panthalingal Krishna Menon, Subodh Kumar Rana, Jagannath Anantarao Sonde, Shrikrishna Shridhar Godbole, Mahmood Ali Khan, Vasudeo Balakrishna Kale, Mathura Prasad Varma, Prafulla Kumar Ray, Amarendra Kumar Daw, Chintaman Shringapur Ramchandra, Binay Kumar Nandy, Benoy Krishna Bose, Shreedhar Shree Nivas Kirtane, Sadashiv Mahadev Apte, Binay Krishna Bhattacharyya, Ram Ekbal Sinha, Muthuswamy Natarajan, Asghar Naim Ansari, Shunmugavel Maragathavel, Patrik Francis Mathias, Uttam Singh Sidhu, Anilkumar Maganlal Patel, Alfred David Paul, Kumbakonam Srinivasarao Sarangpani, Vasudeo Anant Mauskar, Viswanatha Sankaran, Rabindra Nath Gupta, Perinbam Thanaratnam, Duvoor Jagannatha Reddy, Tindivanam Ramanujam Muthuramangam, Kirpal Singh, Rajanga Nataraja Aiyer, Charlie Lachlan Joshee, Duraiswami Jayaram, Lekshumana Rajagopale Marthandam, Kandukur Prabhakaram, Arcot Govindaraj Rangaraj, Reginald Anthony Jansen, Noble Adisesiah, Tanjore Daivasithamani Gowri Sankar

*Lieutenants (on probation) to be Captains  
(on probation)*

Ram Swarup Verma, Alanghatucaren Anthony Porinchu, Mangudi Kailasa Swaminadhan, Sudhir Chandra Ghosh, Narayana Kartha Gangadhara Kartha, Mohan Lal Sur, Faqir Mohammad Khan, Gadicharla Jagannatha Rao, Unniparambathi Velayudha Menon, Pafuri Ramachandra Rao, Thoppil Chandy Varghese, Kuttappan Nair Ramakrishnan Thampi, Bir Bal Sahni, Lakshman Raghvendra Rao Lakshkar, Plammood House Krishnan Pandalai Sankaran Nair, Gurbachan Singh, Sahdev Virmani, Maniketh Chakrapani Menon, Raman Madhavan Nair, Ananthacharlu Krishnaswami, Alumootil George David, Abdul Ghaffar, Madduloori Wilson William, Mohammad Arshad, Anaikuppam Ramaswami Subrahmanyam, Pisipati Venkatnarayan, Krishnaswami Kalyana Sundaram, Varanasi Peddavadhani Somayazulu Sarma, Rustum Bomanji Daruvala, Raymond Vivian Norman Nayud, Nyapati Vasudeva Rao, Binay Kumar Banerji, Subramonia Pillai Kumara Pillai, Jayantilal Vithaldas Karia, Dalip Shah Singh, Koduvayur Matilakath Unnikrishnan, Thakar Singh Chohan, Havaligi Mruthyunjaya Rao, Mohamad Tajuddin, Ghyasuddin Ahmed, Hemanta Kumar Das, Dilip Kumar Sen, Manzur Ilahi Khwaja, Sudhir Kumar Mazumdar, Phanindra Nath Banerjee, Surath Kumar Bhattacharjee, Vishwambhar Nath Chaturvedi, Vaithinathaswamy Swaminathan, Krishna Pillay Mahadevan Pillay, Ram Kumar Saksena, Dinsukhlal Tribhovandas Gandhi, Kidar Nath Bali, Frederick Maitland James, Vinayak Santayya Achrekar, Khagendra Nath Ghose, Venkat Raghunath Mirajkar, Pattathil Kerala Varma, Parimal Chandra Banerjee, Balwant Sadashiv Patankar, Puthenpurail Idichandy Alexander, Natverlal Ratanlal Dani, Puttige Ramachandra Sastry, Amar Kumar Ghosh, Devadason, George Alexander Roche, Chempottil Madhava Menon, Kundadak Madhav Kudva, Pillalamarri Jagannathan, Vijaykant Atmaram Rane, Velloor Sangameswara Sastri Ramaswami, Vithalabhai Bhailalbhai Patel, Ranjit Singh Garewal, Mohammad Sher Rana, Mohan Prakash Goel, Faiz-Ullah Khan, Balram Singh Baswani, Vadavath Kumar Gangadhara Menon, Mohammad Shoaib Mallick, Mihir Kumar Bose, Atmaram Parasharam Diwan, Malayil Coshv Mathew, Maddim Setti Venkataswami Naidu, Venkatesh Vasudeo Ainapure, Padiath Mohamed Ali, Sankari Prasad Sinha Roy, Man Mohan Singh, Vaidhyananthapuram Subramaniaier Gopalakrishnan, Nalin Behari Chaudhury, Himansu Sekhar Sinha, Gnanabaranam David Pillai, Venkiteswara Krishna Prabhu, Satyendra Ramchandra Turkhud, Krishna Rao Rajagopal, Kurupathi Balakrishnan Nair, Barkey Kuruvilla, Kakumanu Vullakki, Abdul Walid Fazlur Rahman, Labhshanker Revashanker Mankodi, Paresch Chandra Ghosh, Simhadri Govinda Audinayana Raju, Nitya Pada Kundu, Phani Bhushan Chakerberty, Kadayam Sreenivasa Iyer Sankaran, P. Vadivale, Gundu Gurty Sanyasi Rao, Jagdeo Bahadur Singh, Rathindra Nath Mitra, Ganga Prasad Srivastava, Krishna Nand Joshie, Mandalika Rana

Subha Rao, Arcot Chandramowli Sastri, Joseph Eapen, Giri Sree Ramulu, Shyam Nath Chack, Uma Prasanna Mukherjee, Ram Krishna Mendireth, Abdul Bashir, Korattiswaroopam Kochukuttan Thampuran, N. S. Sankara Narayanan, Vadakkedeth Krishnankutty Menon, Surath Madhava Rao, N. Sri Dhara Rao, Basheshar Nath Bali, Ramavaram Sreenivasam Kesavaraaj, Dina Nath Maniktala, Vasant Ramrao Sanzgiri, Bhadrappa Devadas, Mani Mohan Chakravarti, Bhattiprolu Sundaramamurti, Obaidiah David, Venkataraman Hari Haran, Kalpathi Venkateswara Ganapathi, Francis Freitas, Hem Chandra Bhattacharyya, Ram Layak Singh, Ratilal Chimanlal Swaminarayan, Ashoka Hirananda Vatsyayana, James Kanakaraaj Lucas, Thelapurath Narayana Srikumara Kurup, Shaikh Mohammad Yunus Farooqui, Arza Janak-mohun Rao, Codanda Bopana Kariapa, Frederick Mervin Faulkland Forrest, Hemendra Kumar Basu, Sultan Ahmad Khan, Naba Kumar Mukherjee, Sachindra Nath Basu, Sachikanta Sen, Sanat Kumar Ghosh, Anil Chandra Ghosh, Ezekiel Abraham Shellim, Sailendra Nath Chowdhury Bona, Dharendra Nath Bhattacharya, Dines Chandra Chaudhuri, Tara Singh Grewal, Kumudranjan Paramanik, Adya Nath Ray, Nirbahya Thakar, Kundan Lal, Ravanasmudram Viswanathier Padmanabhan, Valparambil Karappan Kumaran, Abraham Solomon Norman, Tarak Das Chatterjee, Daljit Singh Goel, Arulappan Paul Devadoss.

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## Original Articles

### AFTER-HISTORIES OF TUBERCULOUS PATIENTS

By P. V. BENJAMIN, M.B., B.S., T.D.D. (Wales)  
*Medical Superintendent, Union Mission Tuberculosis Sanatorium, Arogyavaram, near Madanapalle*

THE value of treatment of tuberculous patients in an institution can be judged in two ways:—

- (1) By the results of treatment up to the time of the patient's leaving the institution.
- (2) By the ability of the patient to survive after leaving the institution.

We know from sanatoria all over the world that the immediate results of treatment have improved considerably especially during the last two decades, and also since the wide adoption of various methods of collapse therapy. This improvement has extended to the later results of treatment, that is, after the patient has left the institution, but the improvement in this respect has not been so marked as was expected, although reports from different institutions vary. Hartley and his co-workers (1935) after analysing by statistical methods the figures for 8,766 cases treated in Frimley Sanatorium, England, draw the conclusion 'that the prognosis of an average case of pulmonary tuberculosis has not materially changed during the past thirty years, and that our patients of more recent years show an after-history very similar to those of cases treated in the earlier period'. They do however admit that patients who have been able to get a successful pneumothorax do definitely have a better expectation of life.

On the other hand, Midhurst Sanatorium, England, in a follow up of about thirty years, records in its Annual Report (1936), a decrease in mortality of 20 per cent in recent years compared with the period before 1920. Cheshire Joint Sanatorium in its Annual Report (1936) records a decrease of 30 per cent in mortality three years after discharge.

Looked at from another point of view, we see that the percentage of deaths for all tuberculous patients still remains very high even after good results of treatment. London County Council figures, reviewing about 4,000 patients each year from the years 1921-29, considering each patient five years after completion of treatment, record a survival percentage varying between 31.9 and 36.1; for the sputum-positive advanced cases the percentage of survival was between 3.7 and 6.9; for the sputum-positive moderately advanced cases between 28.4 and 35.2 per cent; and for the sputum-positive minimal cases between 60.1 and 72.1 per cent.

Figures from Trudeau Sanatorium, U. S. A., which takes mostly patients of good social status are rather better (Heise and Hennigar, 1933);

of 708 patients with minimal disease, 660 or 93 per cent are known to be alive five years later; of 2,192 patients with moderately advanced disease, 1,874 or 85 per cent; of 478 patients with far advanced disease, 253 or 53 per cent.

In Fort Qu'Appelle Sanatorium (Ferguson, 1926) of 407 stage I patients discharged between one and seven years previously, 90.4 per cent were alive; and 83 per cent of stage II patients, and 47.9 per cent of stage III patients were found alive.

In order to try to find out what is the position in India, the sanatorium at Arogyavaram has attempted to collect after-histories of all patients discharged from the institution, who have had at least one month's treatment (those who died while under treatment in the sanatorium are not included in the figures). These figures have been collected in 1925, 1930, 1935 and 1940 for patients who had completed a period of five years after leaving the sanatorium prior to those years.

#### *Immediate results of treatment*

During these years there has been a steady improvement in the immediate results of treatment as shown by the following table (table I).

In table I are shown those patients discharged as 'arrested' and 'much improved', who could be expected to have a fair prospect of doing well in after-life. Taken together in stage I good results have increased from 85.8 to 96.8 per cent during the several five-year periods, in stage II from 58.3 to 82.8, and in stage III from 21.2 to 40.9. Are these results carried over into the after-history?

#### *After-histories of the patients*

Enquiries were made about all the 3,945 patients of pulmonary tuberculosis discharged after treatment between the years 1916-35. In such an enquiry, it is at present impossible in India to get a really satisfactory number of replies. Answers were received concerning only 2,424, i.e., 61.4 per cent of all the cases. The distribution of these patients is shown in table II, where it will be seen that the traced and untraced cases are fairly evenly distributed over the different stages and different results of treatment in each stage.

It is recognized that it is very difficult to draw statistical conclusions when as many as 39 per cent of the cases are untraced. One method, which gives the most unfavourable picture, is to assume all the untraced cases as dead, but we believe that this would not give a correct picture. While it is possible that the majority of untraced stage III patients may have died, it is very unlikely that this is true for the stages I and II patients. Another way is to ignore the untraced cases and to deal only with the traced cases, realizing that possibly the figures for survival in stage III are an over-estimate, because probably most of the patients

TABLE I  
Immediate results of treatment of 5,789 patients

| Years      | Total | ARRESTED |             | MUCH IMPROVED |             | IMPROVED |             | STATIONARY OR WORSE |             | DIED    |             |
|------------|-------|----------|-------------|---------------|-------------|----------|-------------|---------------------|-------------|---------|-------------|
|            |       | Num-ber  | Per-centage | Num-ber       | Per-centage | Num-ber  | Per-centage | Num-ber             | Per-centage | Num-ber | Per-centage |
| Stage I    |       |          |             |               |             |          |             |                     |             |         |             |
| 1916-20 .. | 253   | 179      | 70.8        | 38            | 15.0        | 25       | 9.8         | 8                   | 3.2         | 3       | 1.2         |
| 1921-25 .. | 146   | 104      | 71.3        | 32            | 21.9        | 5        | 3.4         | 5                   | 3.4         | ..      | ..          |
| 1926-30 .. | 267   | 224      | 83.9        | 29            | 10.9        | 7        | 2.6         | 7                   | 2.6         | ..      | ..          |
| 1931-35 .. | 213   | 178      | 83.6        | 25            | 11.7        | 8        | 3.8         | 2                   | 0.9         | ..      | ..          |
| 1936-40 .. | 154   | 127      | 82.5        | 22            | 14.3        | 4        | 2.6         | 1                   | 0.6         | ..      | ..          |
| TOTAL ..   | 1,033 | 812      | 78.6        | 146           | 14.1        | 49       | 4.8         | 23                  | 2.2         | 3       | 0.3         |
| Stage II   |       |          |             |               |             |          |             |                     |             |         |             |
| 1916-20 .. | 376   | 118      | 31.4        | 101           | 26.9        | 74       | 19.7        | 69                  | 18.3        | 14      | 3.7         |
| 1921-25 .. | 211   | 62       | 29.4        | 95            | 45.0        | 26       | 12.3        | 24                  | 11.4        | 4       | 1.9         |
| 1926-30 .. | 288   | 91       | 31.7        | 131           | 45.5        | 29       | 10.2        | 33                  | 11.2        | 4       | 1.4         |
| 1931-35 .. | 237   | 57       | 24.0        | 135           | 57.0        | 31       | 13.1        | 8                   | 3.4         | 6       | 2.5         |
| 1936-40 .. | 174   | 36       | 20.6        | 108           | 62.2        | 21       | 12.1        | 7                   | 4.0         | 2       | 1.1         |
| TOTAL ..   | 1,286 | 364      | 28.3        | 570           | 44.4        | 181      | 14.1        | 141                 | 10.9        | 30      | 2.3         |
| Stage III  |       |          |             |               |             |          |             |                     |             |         |             |
| 1916-20 .. | 193   | 0        | 0.0         | 41            | 21.2        | 32       | 16.6        | 89                  | 46.1        | 31      | 16.1        |
| 1921-25 .. | 471   | 3        | 0.7         | 89            | 18.9        | 93       | 19.8        | 193                 | 40.9        | 93      | 19.7        |
| 1926-30 .. | 640   | 6        | 0.9         | 217           | 33.9        | 106      | 16.6        | 218                 | 34.1        | 93      | 14.5        |
| 1931-35 .. | 1,013 | 2        | 0.2         | 388           | 38.3        | 224      | 22.1        | 284                 | 28.1        | 115     | 11.3        |
| 1936-40 .. | 1,153 | 1        | 0.1         | 470           | 40.8        | 244      | 21.2        | 295                 | 25.6        | 143     | 12.4        |
| TOTAL ..   | 3,470 | 12       | 0.3         | 1,205         | 34.8        | 699      | 20.1        | 1,079               | 31.1        | 475     | 13.7        |

TABLE II

Immediate results on discharge of 3,945 patients treated during 1916-35 showing the distribution of the traced and the untraced cases, five years or more later

| Stages | Number of patients |          | ARRESTED |             | MUCH IMPROVED |             | IMPROVED |             | WORSE   |             | TOTAL   |             |
|--------|--------------------|----------|----------|-------------|---------------|-------------|----------|-------------|---------|-------------|---------|-------------|
|        |                    |          | Num-ber  | Per-centage | Num-ber       | Per-centage | Num-ber  | Per-centage | Num-ber | Per-centage | Num-ber | Per-centage |
| I      | 876                | Traced   | 442      | 64.5        | 81            | 65.4        | 27       | 60.0        | 12      | 54.5        | 562     | 64.2        |
|        |                    | Untraced | 243      | 35.5        | 43            | 34.6        | 18       | 40.0        | 10      | 45.5        | 314     | 35.8        |
| II     | 1,084              | Traced   | 207      | 63.1        | 257           | 55.7        | 75       | 46.8        | 79      | 58.9        | 618     | 57.1        |
|        |                    | Untraced | 121      | 36.9        | 205           | 44.3        | 85       | 53.2        | 55      | 41.1        | 466     | 42.9        |
| III    | 1,985              | Traced   | 8        | 72.7        | 433           | 58.9        | 286      | 62.8        | 520     | 66.4        | 1,247   | 62.8        |
|        |                    | Untraced | 3        | 27.3        | 302           | 41.1        | 169      | 37.2        | 264     | 33.6        | 738     | 37.2        |

in this stage and about whom information cannot be obtained, have died.

In table III are shown the percentages of survival calculated according to both these methods divided according to the stage of the disease on admission, and the result of treatment on discharge in each of the five-year groups.

From table III it will be seen that at the very lowest computation 56.3 per cent of the discharge cases of stage I were alive five years later; 38.0 per cent of stage II and 16.5 per cent of stage III, or taking all stages together 31.2 per cent. If we take only the traced cases we find that in stage I, 87.7 per cent are alive; in stage II

TABLE III  
After-histories of 3,945 patients in relation to stage and immediate results of treatment

| Stages     | Years   | ARRESTED                    |                            |                      |        |                          | MUCH IMPROVED               |                            |                      |        |                          | IMPROVED                    |                            |                      |        |                          | STATIONARY OR WORSE         |                            |                      |        |                          | TOTAL FOR STAGE |                      |                            |                             |  |
|------------|---------|-----------------------------|----------------------------|----------------------|--------|--------------------------|-----------------------------|----------------------------|----------------------|--------|--------------------------|-----------------------------|----------------------------|----------------------|--------|--------------------------|-----------------------------|----------------------------|----------------------|--------|--------------------------|-----------------|----------------------|----------------------------|-----------------------------|--|
|            |         | Percentage living of traced | Percentage living of total | Known living, 5 yrs. | Traced | Total number of patients | Percentage living of traced | Percentage living of total | Known living, 5 yrs. | Traced | Total number of patients | Percentage living of traced | Percentage living of total | Known living, 5 yrs. | Traced | Total number of patients | Percentage living of traced | Percentage living of total | Known living, 5 yrs. | Traced | Total number of patients | Traced          | Known living, 5 yrs. | Percentage living of total | Percentage living of traced |  |
| I          | 1916-20 | 86.9                        | 50.9                       | 93                   | 107    | 179                      | 72.7                        | 42.1                       | 16                   | 22     | 38                       | 76.9                        | 41.7                       | 10                   | 13     | 24                       | 76.9                        | 41.7                       | 0                    | 2      | 8                        | 144             | 119                  | 47.6                       | 82.6                        |  |
|            | 1921-25 | 88.6                        | 67.3                       | 70                   | 79     | 104                      | 88.5                        | 71.9                       | 23                   | 26     | 32                       | 66.7                        | 40.0                       | 2                    | 3      | 5                        | 66.7                        | 40.0                       | 0                    | 5      | 5                        | 113             | 95                   | 65.1                       | 84.1                        |  |
|            | 1926-30 | 93.5                        | 64.3                       | 144                  | 154    | 224                      | 83.3                        | 51.7                       | 15                   | 18     | 29                       | 87.5                        | 87.5                       | 7                    | 8      | 8                        | 87.5                        | 87.5                       | 0                    | 4      | 7                        | 184             | 166                  | 62.2                       | 90.2                        |  |
|            | 1931-35 | 97.1                        | 55.6                       | 99                   | 102    | 178                      | 86.7                        | 52.0                       | 13                   | 15     | 25                       | 33.3                        | 12.5                       | 1                    | 3      | 8                        | 33.3                        | 12.5                       | 0                    | 1      | 2                        | 121             | 113                  | 53.5                       | 93.4                        |  |
|            | 1916-35 | 91.8                        | 59.3                       | 406                  | 442    | 685                      | 82.7                        | 54.0                       | 67                   | 81     | 124                      | 74.1                        | 44.4                       | 20                   | 27     | 45                       | 74.1                        | 44.4                       | 0                    | 12     | 12                       | 562             | 493                  | 56.3                       | 87.7                        |  |
| II         | 1916-20 | 81.7                        | 56.8                       | 67                   | 82     | 118                      | 55.9                        | 32.7                       | 33                   | 59     | 101                      | 50.0                        | 16.2                       | 12                   | 24     | 74                       | 50.0                        | 16.2                       | 9                    | 39     | 69                       | 204             | 121                  | 33.4                       | 59.3                        |  |
|            | 1921-25 | 86.8                        | 53.2                       | 33                   | 38     | 62                       | 84.0                        | 44.2                       | 42                   | 50     | 95                       | 50.0                        | 34.6                       | 9                    | 18     | 26                       | 50.0                        | 34.6                       | 2                    | 14     | 24                       | 120             | 86                   | 41.5                       | 71.7                        |  |
|            | 1926-30 | 86.7                        | 58.2                       | 52                   | 60     | 91                       | 75.9                        | 45.8                       | 60                   | 79     | 131                      | 47.4                        | 31.0                       | 9                    | 19     | 29                       | 47.4                        | 31.0                       | 2                    | 22     | 33                       | 180             | 123                  | 43.3                       | 68.3                        |  |
|            | 1931-35 | 81.5                        | 38.6                       | 22                   | 27     | 57                       | 79.7                        | 40.7                       | 55                   | 69     | 135                      | 38.5                        | 16.1                       | 5                    | 13     | 31                       | 38.5                        | 16.1                       | 0                    | 5      | 8                        | 114             | 82                   | 35.9                       | 71.9                        |  |
|            | 1916-35 | 84.1                        | 53.0                       | 174                  | 207    | 328                      | 73.9                        | 41.1                       | 190                  | 257    | 462                      | 47.3                        | 21.9                       | 35                   | 74     | 160                      | 47.3                        | 21.9                       | 13                   | 80     | 134                      | 618             | 412                  | 38.0                       | 66.7                        |  |
| III        | 1916-20 | 33.3                        | 0.0                        | 0                    | 0      | 0                        | 35.5                        | 26.8                       | 11                   | 31     | 41                       | 12.0                        | 9.4                        | 3                    | 25     | 32                       | 12.0                        | 9.4                        | 2                    | 62     | 89                       | 118             | 16                   | 9.8                        | 13.6                        |  |
|            | 1921-25 | 100.0                       | 66.7                       | 2                    | 2      | 3                        | 56.5                        | 39.3                       | 35                   | 62     | 93                       | 25.0                        | 17.2                       | 16                   | 64     | 193                      | 25.0                        | 17.2                       | 2                    | 137    | 193                      | 265             | 55                   | 14.6                       | 20.7                        |  |
|            | 1926-30 | 100.0                       | 50.0                       | 3                    | 3      | 6                        | 62.9                        | 41.5                       | 90                   | 141    | 217                      | 29.7                        | 20.8                       | 22                   | 74     | 106                      | 29.7                        | 20.8                       | 2                    | 149    | 218                      | 367             | 117                  | 21.4                       | 31.8                        |  |
|            | 1931-35 | 0.0                         | 0.0                        | 0                    | 0      | 2                        | 59.8                        | 30.7                       | 119                  | 199    | 388                      | 13.8                        | 7.6                        | 17                   | 123    | 224                      | 13.8                        | 7.6                        | 3                    | 172    | 284                      | 494             | 139                  | 15.5                       | 28.1                        |  |
|            | 1916-35 | 75.0                        | 54.5                       | 6                    | 8      | 11                       | 58.9                        | 34.7                       | 255                  | 433    | 735                      | 20.3                        | 12.7                       | 58                   | 286    | 455                      | 20.3                        | 12.7                       | 9                    | 520    | 784                      | 1,244           | 327                  | 16.5                       | 26.3                        |  |
| All stages | 1916-35 | 89.4                        | 57.2                       | 585                  | 654    | 1,024                    | 66.4                        | 38.7                       | 512                  | 771    | 1,321                    | 29.2                        | 17.1                       | 113                  | 387    | 660                      | 29.2                        | 17.1                       | 22                   | 612    | 940                      | 2,424           | 1,232                | 31.2                       | 50.8                        |  |



66.7 per cent and in stage III 26.3 per cent, but as we have already stated these figures especially for stage III may be too high.

If we add together the arrested and much improved, i.e., those who could be expected to do well after discharge, and can be called 'clinically well', we find the following :—

TABLE IV  
*After-histories of patients discharged as  
'clinically well'*

| Stage | Total number of patients | Number of patients traced | KNOWN TO BE LIVING, 5 YEARS LATER |                            | Percentage of traced cases |
|-------|--------------------------|---------------------------|-----------------------------------|----------------------------|----------------------------|
|       |                          |                           | Number                            | Percentage of all patients |                            |
| I     | 809                      | 523                       | 473                               | 58.5                       | 90.6                       |
| II    | 790                      | 464                       | 364                               | 45.5                       | 78.4                       |
| III   | 746                      | 441                       | 261                               | 34.9                       | 59.2                       |

From table IV it will be seen that at the very lowest estimate 34.9 per cent of the stage III cases discharged as 'clinically well' are alive five years later, 45.5 per cent of the stage II and 58.5 per cent of stage I.

A consideration of the after-histories for the various five-year periods (table III) does not show any marked and progressive improvement in results, except that the results for the years 1921-35 are better than for the first five-year period; collapse therapy was begun in 1921 and may have contributed to this improvement.

#### *After-care and after-history*

If only the 'traced' cases are taken into consideration, it will be seen (table IV) that 90.6 per cent of the cases of stage I discharged as 'clinically well', are alive at the end of five years, the percentages of such cases of the stages II and III being 78.4 and 59.2. Thus, at least 9.4, 21.6 and 40.8 per cent of such cases, in the 1st, 2nd and 3rd stages of the diseases, respectively, have died in five years. These figures are for all the patients discharged, irrespective of special after-care.

Similar figures for patients who have had special after-care are not easily available. In this sanatorium, 91 patients have had after-care after discharge either on the sanatorium staff or in the ex-patients' colony, for periods varying from one to twenty-six years. Of these, 38 out of such 53 stage III patients, i.e., 71.7 per cent, are alive and working. The corresponding figure for such patients not receiving any special after-care, is 34.9 per cent if the untraced cases are considered as dead, or 59.2 if the untraced cases are omitted from the analyses. Although the number of patients receiving after-care is small, yet the results seem definitely to prove the value

of such after-care, even if a few of the ex-patients have not yet completed five years after discharge. The ex-patients in this group were not selected because they were specially well, but more often because they needed continued medical supervision.

Similar figures showing the value of after-care are available for the Rhode Island State Sanatorium in U. S. A., where Barnes (1919) states that only 55 per cent of patients who left the sanatorium as improved are alive two to twelve years later, while of 286 ex-patients who were employed on the staff of the sanatorium 69 per cent were alive after the same period.

#### *The place of clinics in after-care*

In India it will be many years before after-care centres, in places like colonies or institutions, can deal with more than a mere fraction of the discharged cases needing after-care. But the tuberculosis clinics that are now being established all over India, can do much if their functions are properly understood and carried out.

One of the things we have found in our ex-patients' colony is that the ex-patients frequently need close medical supervision and treatment, especially in the earlier years after discharge. The availability of this has contributed much to the higher survival rate. This type of supervision can be carried out by the clinic during the first years after discharge, but there must be co-operation between the clinic and the sanatorium or other institution in which the patient has been treated. Of recent years it has been possible to refer some of our cases on discharge to clinics, and the value of such subsequent supervision has been encouraging.

Further, the after-care committee, which should be a part of the clinic's organization, can help by arranging suitable work or living conditions for the ex-patients. In addition, co-operation between clinic and sanatorium will facilitate the tracing of patients so that we shall be able in course of time to get much more reliable figures for after-histories.

#### *Conclusion*

From the above study of the fate of discharged patients in India, it will be seen that the survival rate compares very favourably with those of other countries. The difficulty of tracing patients after discharge is very great, but in course of time with progress of education and with the increasing co-operation of clinics and general practitioners, this difficulty should decrease, and more reliable figures become available. As elsewhere, there is a fairly high percentage of deaths after discharge, specially in the patients who were suffering from advanced disease, but efficient after-care can help much in reducing the mortality.

(Concluded on opposite page)

# THORACOPLASTY IN THE TREATMENT OF PULMONARY TUBERCULOSIS

## AN ANALYSIS OF 150 CASES

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ONLY a few reports on thoracoplasty have appeared so far from India. From this sanatorium a review of the first seventeen patients operated on was published in 1937 (Benjamin). From the Wanless Sanatorium, Miraj, two reports, on 110 and 94 patients, respectively, have been given by Jones (1937 and 1939). As a wider knowledge of the value, possibilities and limitations of thoracoplasty in Indian patients is desirable, we are presenting the experience gained from our first 150 patients treated by thoracoplasty.

From 1932 to the end of July 1942, 194 patients have had a thoracoplasty with a total of 455 operations. For the purpose of this

investigation we have taken the first 150 of these patients, the last being operated on in November 1941 and so having had an observation period of nine months. The 17 cases already reported by Benjamin in 1937 are included in this series. On these 150 patients, 347 operations were done, that is an average of two to three operations for each patient.

Before examining the results it should be understood that these cases constitute a group of tuberculous patients in whom all other forms of treatment had failed. All had tubercle bacilli in their sputum before the operation; all except a very few had definite cavities, often of considerable size. In all cases pneumothorax treatment had been attempted; in about one-third of the cases a pneumothorax had been induced, but had to be abandoned after some months when found to be ineffective. In the other cases no free pleural space was found, or, at the most, only very small pockets. Most of the patients had been a long time under institutional treatment, and it was very unlikely that further conservative treatment would be of any use. Without surgical treatment the majority would probably have succumbed to their disease, and, if sent home, all would certainly have been a constant source of infection to their surroundings. It should therefore be borne in mind that we here are dealing with a group of patients with serious forms of tuberculosis and for whom the prognosis was very unfavourable.

The material presented includes patients from all parts of India. The majority (125 patients) were Indians, mostly from South India, but many also from the central and northern provinces; the other patients were 14 Anglo-Indians, 4 Europeans, 4 Burmans, 2 Anglo-Burmans and 1 Chinese. It has been difficult to get information from all after discharge, as many, due to the present war situation, have moved from their homes on the East coast to the interior; from the patients living in Burma we have of course been cut off. The results of the operation are based upon the condition on discharge when no later information has been available. The period of observation therefore shows much variation ranging from six months up to nine years, in the earlier cases, the majority being between one and two years with an average of one year and five months.

### Operative technique

During the first part of this series, nitrous-oxide was used as general anaesthesia, but as there was reason to suspect that ill effects were caused by this anaesthesia, in one case perhaps even death, it was given up in favour of ether. We now use a combination of local anaesthesia with procaine, and general ether anaesthesia with a little chloroform at the beginning.

All the operations, except one, were done by means of a posterior paravertebral incision. In the earlier years it was common to do the

(Continued from previous page)

### Summary

(1) A review is made of the after-histories of 3,945 patients five years after treatment at Arogyavaram.

(2) Replies were received about only 2,424 patients, and the difficulty of drawing conclusions when 39 per cent of patients are untraced and unknown, is discussed.

(3) Survival figures have been calculated on two different principles: firstly, considering as dead all the untraced cases (the worst possible figure) and secondly, ignoring the untraced cases.

(4) While immediate results of treatment have shown definite improvement in all the five-year period since 1915, a corresponding improvement in after-histories is not observed except that all the five-year periods since 1920 show better results than the period 1915-20.

(5) The influence of after-care on survival is discussed and illustrated by figures from a group of ex-patients working in the sanatorium and ex-patients' colony.

(6) In the absence of colonies for ex-patients in India, the place of the tuberculosis clinic in after-care is discussed.

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TABLE I  
Results in one hundred and fifty thoracoplasty patients

| Type of operation         | Number of patients | CLINICAL RESULTS |           |                     |                   |  |                  | Sputum results |         |               |  |
|---------------------------|--------------------|------------------|-----------|---------------------|-------------------|--|------------------|----------------|---------|---------------|--|
|                           |                    | Living           |           |                     | Died              |  |                  | O TB           | ± TB    | + TB          |  |
|                           |                    | Much improved    | Improved  | Stationary or worse | During first week | During second week to 2 months inclusive | After two months |                |         |               |  |
| Modified Brauer-Friedrich | 16                 | %<br>7 = 43.8    | %<br>..   | %<br>1 = 6.2        | %<br>3 = 18.7     | %<br>1 = 6.2                             | %<br>4 = 25.0    | %<br>3 = 18.7  | %<br>.. | %<br>5 = 31.2 |  |
| Men :—                    | 3                  | 1                | ..        | ..                  | 1                 | ..                                       | 1                | 1              | ..      | ..            |  |
| Right side                | ..                 | 3                | ..        | 1                   | 1                 | 1  | 1                | 1              | ..      | 3             |  |
| Left side                 | 7                  | ..               | ..        | ..                  | ..                | ..                                       | ..               | ..             | ..      | ..            |  |
| Total                     | 10                 | 4 = 40           | ..        | 1 = 10              | 2 = 20            | 1 = 10                                   | 2 = 20           | 2 = 20         | ..      | 3 = 30        |  |
| Women :—                  | 2                  | ..               | ..        | ..                  | 1                 | ..                                       | 1                | 1              | ..      | 2             |  |
| Right side                | ..                 | 3                | ..        | ..                  | ..                | ..                                       | ..               | ..             | ..      | ..            |  |
| Left side                 | 4                  | ..               | ..        | ..                  | ..                | ..                                       | ..               | ..             | ..      | ..            |  |
| Total                     | 6                  | 3 = 50           | 34 = 25.4 | ..                  | 1 = 16.7          | ..                                       | 2 = 33.3         | 1 = 16.7       | ..      | 2 = 33.3      |  |
| Modern type               | 134                | 65 = 47.1        | ..        | 9 = 6.7             | 11 = 8.2          | 6 = 4.5                                  | 11 = 8.2         | 56 = 41.8      | 6 = 4.5 | 44 = 32.8     |  |
| One stage                 | 17                 | 4 = 23.6         | 1 = 5.9   | ..                  | 8 = 47.2          | 2 = 11.8                                 | 2 = 11.8         | 3 = 17.7       | ..      | 2 = 11.8      |  |
| Men :—                    | 4                  | 2                | ..        | ..                  | 1                 | 1  | 1                | 2              | ..      | ..            |  |
| Right side                | ..                 | ..               | ..        | ..                  | 5                 | ..                                       | ..               | ..             | ..      | ..            |  |
| Left side                 | 7                  | ..               | ..        | ..                  | ..                | ..                                       | ..               | ..             | ..      | ..            |  |
| Total                     | 11                 | 2 = 18.2         | ..        | ..                  | 6 = 54.4          | 2 = 18.2                                 | 1 = 9.1          | 2 = 18.2       | ..      | ..            |  |
| Women :—                  | 5                  | 2                | 1         | ..                  | 2                 | ..                                       | 1                | 1              | ..      | 1             |  |
| Right side                | ..                 | ..               | ..        | ..                  | ..                | ..                                       | ..               | ..             | ..      | ..            |  |
| Left side                 | 1                  | ..               | ..        | ..                  | ..                | ..                                       | ..               | ..             | ..      | 1             |  |
| Total                     | 6                  | 2 = 33.3         | 1 = 16.7  | ..                  | 2 = 33.3          | ..                                       | 1 = 16.7         | 1 = 16.7       | ..      | 2 = 33.3      |  |

|                     |     |                 |                |                |                 |       |                |                 |                 |                 |
|---------------------|-----|-----------------|----------------|----------------|-----------------|-------|----------------|-----------------|-----------------|-----------------|
| Two stages          | 52  | 26=50           | 14=26.8        | 4=7.7          | 1=1.9           | 3=6.8 | 4=7.7          | 26=50           | 1=1.9           | 17=32.6         |
| Men:—               |     |                 |                |                |                 |       |                |                 |                 |                 |
| Right side          | 22  | 11              | 5              | 3 <sup>4</sup> | 1 <sup>..</sup> | 2     | 1 <sup>3</sup> | 12              | 1 <sup>..</sup> | 7 <sup>4</sup>  |
| Left side           | 21  | 10              | 6              | 1 <sup>5</sup> | 1               | 1     | 2              | 10              | 1               | 6 <sup>5</sup>  |
| Total               | 43  | 21=48.8         | 11=25.6        | 4=9.3          | 1=2.3           | 3=6.7 | 3=6.7          | 22=51.2         | 1=2.3           | 13=30.2         |
| Women:—             |     |                 |                |                |                 |       |                |                 |                 |                 |
| Right side          | 6   | 3               | 2 <sup>0</sup> | ..             | ..              | ..    | 1              | 3               | ..              | 2 <sup>0</sup>  |
| Left side           | 3   | 2               | 1              | ..             | ..              | ..    | ..             | 1               | ..              | 2               |
| Total               | 9   | 5=55.6          | 3=33.3         | ..             | ..              | ..    | 1=10.1         | 4=44.4          | ..              | 4=44.4          |
| Three stages        | 52  | 28=53.8         | 14=26.8        | 4=7.7          | 1=1.9           | 1=1.9 | 4=7.7          | 24=46.2         | 3=5.8           | 19=38.6         |
| Men:—               |     |                 |                |                |                 |       |                |                 |                 |                 |
| Right side          | 19  | 9 <sup>5</sup>  | 7              | 2              | 1               | ..    | 4 <sup>5</sup> | 7               | 1               | 10 <sup>7</sup> |
| Left side           | 14  | 7               | 3              | ..             | ..              | ..    | ..             | 6               | ..              | 4               |
| Total               | 33  | 16=48.6         | 10=30.3        | 2=6.1          | 1=3.0           | ..    | 4=12.1         | 13=39.3         | 1=3.0           | 14=42.4         |
| Women:—             |     |                 |                |                |                 |       |                |                 |                 |                 |
| Right side          | 6   | 1               | 2              | 2              | ..              | 1     | ..             | 1               | 1               | 3               |
| Left side           | 13  | 11 <sup>0</sup> | 2              | ..             | ..              | ..    | ..             | 10 <sup>0</sup> | 1               | 2               |
| Total               | 19  | 12=63.1         | 4=21.1         | 2=10.5         | ..              | 1=5.3 | ..             | 11=57.9         | 2=10.5          | 5=26.3          |
| Four stages or more | 13  | 5=38.5          | 5=38.5         | 1=7.7          | 1=7.7           | ..    | 1=7.7          | 3=23.1          | 2=15.4          | 6=46.2          |
| Men:—               |     |                 |                |                |                 |       |                |                 |                 |                 |
| Right side          | 6   | 2               | 3              | 1              | ..              | ..    | 1              | 1               | 1               | 3               |
| Left side           | 5   | 2               | 2              | ..             | ..              | ..    | ..             | 2               | ..              | 3               |
| Total               | 11  | 4=36.3          | 5=45.4         | 1=9.1          | ..              | ..    | 1=9.1          | 3=27.2          | 1=9.1           | 6=54.6          |
| Women:—             |     |                 |                |                |                 |       |                |                 |                 |                 |
| Right side          | 1   | ..              | ..             | ..             | 1               | ..    | ..             | ..              | 1               | ..              |
| Left side           | 1   | 1               | ..             | ..             | ..              | ..    | ..             | ..              | ..              | ..              |
| Total               | 2   | 1=50            | ..             | ..             | 1=50            | ..    | ..             | ..              | 1=50            | ..              |
| GRAND TOTAL         | 150 | 70=46.7         | 34=22.7        | 10=6.7         | 14=9.3          | 7=4.7 | 15=10.0        | 59=39.3         | 6=4.0           | 49=32.7         |

Notes.—(1) Case of tuberculous empyema, operated in two stages.

(2) Operation incomplete, patient had to leave for family reasons.

(3) Sputum became TB-negative but patient died from extrapulmonary dissemination.

(4) Included a case of an antero-lateral thoracoplasty *ad modum* Ascoli.

(5) One patient refused the planned third stage.

(6) One of the two patients left against advice although operation incomplete (third stage intended).

(7, 8 and 9) Included a case operated on for tuberculous empyema with mixed infection.

operation in one stage, removing five to six ribs, but no attempt was made to remove long pieces of rib. In table I the first 16 cases, done by this method, are grouped under the heading 'Modified Brauer-Friedrich'. The majority of these patients had the predominantly fibrotic (chronic) type of disease, one of the criteria commonly accepted at that time for selecting patients for thoracoplasty. The collapse of the apex obtained by this operation was not always good, but these patients generally responded well. Later, when thoracoplasty was extended to patients with a more exudative type of disease, and when it was also found necessary to remove longer pieces of rib than in the earlier operations, the operation was divided into several stages, as the patients could not stand the more extensive operation so well. In table I these cases are grouped under the heading 'Modern Type'.

It is now our routine to remove only two or three ribs at a stage; the two upper ribs are radically removed during the first stage operation. The posterior ends of the ribs are resected medially as far as the transverse processes, sometimes including a portion of these also. In some cases in which the cavity has been situated anteriorly in the lung, and did not close because of remaining anterior stumps of the upper three ribs, we have had to supplement the posterior operations with an anterior one in order to remove these also.

Clinical results and the results of sputum examination are shown separately; the sputum results refer only to patients who are living. In table II the clinical results are correlated with the sputum results.

*Clinical results.*—By 'much improved' is understood that the patients were so well that they could stand normal life and were fit for work shortly after discharge, though some of them were still TB-positive. As seen from table II, 48 patients (32.1 per cent) were much improved and had negative sputum; as the period of observation is yet rather short, it is too early to call them 'arrested' or 'cured' although we expect most of them will be in course of time. On the other hand, some of the TB-negative patients could only be classified as 'improved', i.e., their general condition was still not sufficiently improved for them to be fit for work.

Almost half of the patients obtained very satisfactory results, 46.7 per cent being 'much improved'; in addition, 22.7 per cent were 'improved' making a total of 69.4 per cent positive results of the operation.

*Sputum results.*—Though the clinical improvement from the point of view of the patient's ability to return to work is important, yet the success of the operation has to be judged by the disappearance of tubercle bacilli from the sputum; this is important not only for the

TABLE II

*Clinical results after thoracoplasty correlated with sputum results in 114 living patients*  
(Percentages calculated on basis of the material of 150 patients)

| Clinical results       | SPUTUM RESULTS |         |           | Total      |
|------------------------|----------------|---------|-----------|------------|
|                        | O TB           | ± TB    | + TB      |            |
|                        | %              | %       | %         | %          |
| Much improved .. ..    | 48 = 32.1      | 5 = 3.3 | 17 = 11.4 | 70 = 46.7  |
| Improved .. ..         | 11 = 7.3       | 1 = 0.7 | 22 = 14.4 | 34 = 22.7  |
| Stationary or worse .. | 0              | 0       | 10 = 6.7  | 10 = 6.7   |
| TOTAL ..               | 59 = 39.3      | 6 = 4.0 | 49 = 32.7 | 114 = 75.9 |

Generally a period of three to four weeks is allowed between the stages. Longer intervals are not desirable because of the rapid regeneration of the ribs, which sometimes takes place in spite of our treating the periosteum with 10 per cent formalin to delay this.

The post-operative treatment follows generally accepted lines, but we stress the importance of a sufficiently long sanatorium regime after the last operation, a minimum of four months, even if the patients' general condition could apparently make an earlier discharge possible.

#### Results

In table I, the patients are grouped according to the number of operations they have had.

patient's own sake but also for the sake of those with whom he has to live and work.

From the western countries statistics each dealing with more than 100 patients and published since 1930, show results of 'arrested' or 'TB-negative' varying from 20 to 75 per cent, the majority from 40 to 50 per cent, as shown by Hein *et al.* (1938) from a survey of the literature available up to 1937. Hein himself obtained 47.8 per cent TB-negative in 280 cases (1938). Since then Edwards, Leggat and Davies (1941) reported 68 per cent in 52 cases, and Meltzer (1941) reached 79 per cent among 143 patients. Jones (1939) from Indian material of 90 cases reported 56.7 per cent 'apparently arrested', all the operations however done

within two years of publication, and the standard for sputum examination is not mentioned.

In estimating the sputum results we have taken the latest information available. Three patients were classified as TB-negative although only negative by direct smear on eight examinations within the last two months before discharge; all the others were either sputum-negative by direct smear at least four months before discharge or had in addition one or more negative sputum cultures as can be seen from the following:—

Sputum was TB-negative by

|                             |    |             |
|-----------------------------|----|-------------|
| direct smear only ..        | .. | 13 patients |
| direct smear and also—      |    |             |
| one sputum culture ..       | .. | 32 "        |
| two sputum cultures ..      | .. | 9 "         |
| three sputum cultures ..    | .. | 3 "         |
| two sputum cultures and one |    |             |
| stomach-wash culture ..     | .. | 1 "         |
| guinea-pig inoculation ..   | .. | 1 "         |

In the '± TB' group are six patients who had shown a negative sputum over a long period after their operation but in whom a single examination by direct smear or culture had shown tubercle bacilli shortly before discharge: in none of these patients could a cavity be detected.

A few patients, who were TB-negative at the time of discharge, have since reported a positive sputum and are therefore grouped under '+ TB'.

The standard adopted in our investigation for sputum examination should be borne in mind when our results are compared with statistics of an earlier date, or from institutions where cultivation for tubercle bacilli is not carried out, or where the standard for negative sputum is not given.

From table I it can be seen that our thoracoplasty results have improved with the modern technique. Although in the earlier group (modified Brauer-Friedrich) 43.8 per cent were 'much improved' compared with 47.1 per cent of the 134 patients of the modern type operation, only 18.7 per cent became TB-negative against 41.8 per cent in the latter group. The number of patients in the first group is small but the difference in percentage is sufficiently large to be considered significant. The better sputum result after the modern type of operation may be explained by the much improved apical collapse obtained with a radical removal of the upper two ribs.

#### Operative mortality

As suggested in 1930 by Bull at the conference in Oslo of the International Association of Tuberculosis, we have considered deaths within two months after an operation as 'operative deaths'; in table I figures are also given for deaths during the first post-operative week showing the 'immediate operative mortality'.

Of the total number of operations the immediate operative mortality in the whole

material is 4.04 per cent; 14 in 347 operations, and 6.06 per cent for deaths within the first two months. As each patient has had an average of two to three operations, the operative mortality based on the number of patients is higher, namely, 9.3 per cent 'immediate operative' mortality and 14 per cent mortality within two months. Most of the immediate operative deaths occurred after a first stage operation, and most of these again happened during the period when we began to include the less resistant and more acute type of case and changed the technique to removing larger pieces of rib, although still taking as many as three to four ribs during the first stage; our present procedure is to remove only two ribs at the first stage, and those completely, and only in cases when there is no tendency to mediastinal flapping do we remove a portion of the third rib also. This change of technique has we believe contributed to the lower mortality in the later figures. Another contributing factor has been the use of pressure breathing immediately after operations and also during the first week if there is any distress in breathing or tendency to paradoxical respiration.

The decrease of operative mortality may be seen in the following table:—

|                    | Died during first week | Died after first week within 2 months |
|--------------------|------------------------|---------------------------------------|
| First 50 cases ..  | 7                      | 1                                     |
| Second 50 cases .. | 5                      | 4                                     |
| Third 50 cases ..  | 2                      | 2                                     |

Subsequent to the 150 cases in this investigation, 44 more patients have been operated on, 10 were operated on within the last two months and 34 earlier; there have been no deaths either immediate or later.

#### Age

The patients have varied in age from 18 to 49 years, but the majority were between 20 and 30 years of age. An analysis of the results, judged by clinical improvement and disappearance of tubercle bacilli, shows no material difference in the various age groups.

#### Sex, and side of operation

In table III the patients are grouped according to sex and to the side of operation. The totals for men and women show no appreciable difference, nor do the totals for right and left sides, regardless of sex. But analysis of the results in women in relation to the side of operation, seems to give an indication that in women operation on the right side is less favourable than operation on the left. Bull (1930) noted a higher operative mortality for right than left side, especially in women, but Hein (1938) has not been able to substantiate this.



Although the difference observed by us is sufficiently large to be statistically significant, we feel that more material should be collected before we can come to a conclusion.

often the winner (Hein). In many cases we have had to wait until the progressive phase has subsided as shown by a clearing-up of the radiological shadows, the temperature reverting to

TABLE III

*Thoracoplasty results in 150 patients grouped according to sex and the side operated on*

|                | Total | CLINICAL RESULTS |          |                     |                       |                |                | Sputum results |                |      |
|----------------|-------|------------------|----------|---------------------|-----------------------|----------------|----------------|----------------|----------------|------|
|                |       | Living           |          |                     | Died                  |                |                | O TB           | ± TB           | + TB |
|                |       | Much improved    | Improved | Stationary or worse | During first 2 months | After 2 months |                |                |                |      |
| Men—           |       |                  |          |                     |                       |                |                |                |                |      |
| Right .. ..    | 54    | %<br>25 = 46.3   | 15       | 5                   | %<br>6 = 11.2         | 3              | %<br>23 = 42.6 | 2              | %<br>20 = 37.1 |      |
| Left .. ..     | 54    | 22 = 40.7        | 11       | 3                   | 10 = 18.6             | 8              | 19 = 35.2      | 1              | 16 = 29.6      |      |
| Total .. ..    | 108   | 47 = 43.4        | 26       | 8                   | 16 = 14.9             | 11             | 42 = 38.8      | 3              | 36 = 33.3      |      |
| Women—         |       |                  |          |                     |                       |                |                |                |                |      |
| Right .. ..    | 20    | 6 = 30.0         | 4        | 2                   | 5 = 25.0              | 3              | 5 = 25.0       | 1              | 6 = 30.0       |      |
| Left .. ..     | 22    | 17 = 77.3        | 4        | 0                   | 0                     | 1              | 12 = 54.4      | 2              | 7 = 31.8       |      |
| Total .. ..    | 42    | 23 = 54.7        | 8        | 2                   | 5 = 11.9              | 4              | 17 = 40.4      | 3              | 13 = 30.9      |      |
| Men and women— |       |                  |          |                     |                       |                |                |                |                |      |
| Right .. ..    | 74    | 31 = 41.8        | 19       | 7                   | 11 = 14.9             | 6              | 28 = 37.7      | 3              | 26 = 35.2      |      |
| Left .. ..     | 76    | 39 = 51.3        | 15       | 3                   | 10 = 13.3             | 9              | 31 = 40.7      | 3              | 23 = 30.3      |      |
| Total .. ..    | 150   | 70 = 46.7        | 34       | 10                  | 21 = 14.0             | 15             | 59 = 39.3      | 6              | 49 = 32.7      |      |

#### *Suitability for operation*

When considering indications and contraindications for thoracoplasty, it is important not only to select the proper type of case, but also to decide whether the patient is in a suitable phase to stand the operation. It is obvious that if the patient presents a rapid progression of the tuberculous lesion, the operation is risky. It has been said that if it is a question of a race between the disease and the surgeon, the former is most

normal or nearly normal, and a steady or increasing weight curve. These observations are borne out from table IV; the patients are here grouped according to a clinical estimation of their general condition at the time of their first stage.

The figures show in a striking manner how the patients in good general condition fared much better than those in only a fair condition and very much better than those in a poor condition.

TABLE IV

*General condition before operation compared with the results in 150 thoracoplasty patients*

| Pre-operative condition | Total | CLINICAL RESULTS |                |                     |                       |                |                | Sputum results |                |      |
|-------------------------|-------|------------------|----------------|---------------------|-----------------------|----------------|----------------|----------------|----------------|------|
|                         |       | Living           |                |                     | Died                  |                |                | O TB           | ± TB           | + TB |
|                         |       | Much improved    | Improved       | Stationary or worse | During first 2 months | After 2 months |                |                |                |      |
| Good .. ..              | 78    | %<br>50 = 64.2   | %<br>16 = 20.5 | %<br>1 = 1.3        | %<br>7 = 8.9          | %<br>4 = 5.1   | %<br>34 = 43.7 | %<br>4 = 5.1   | %<br>29 = 37.2 |      |
| Fair .. ..              | 58    | 19 = 32.8        | 15 = 25.8      | 6 = 10.3            | 9 = 15.5              | 9 = 15.5       | 21 = 36.2      | 2 = 3.5        | 17 = 29.3      |      |
| Poor .. ..              | 14    | 1 = 7.2          | 3 = 21.4       | 3 = 21.4            | 5 = 35.7              | 2 = 14.3       | 4 = 28.6       | 0              | 3 = 21.4       |      |

We have, rather to our surprise, found that the usual blood examinations such as the erythrocyte sedimentation rate and differential counts of the leucocytes with regard to immature forms (Schilling's method) offer very little guidance in prognosis. Whereas the sedimentation rate proved of no prognostic value at all, the ratio of immature neutrophile leucocytes (Schilling's 'stabkernige') proved to be of some value, but this only in certain cases. The value of these blood tests cannot be compared with the value of general clinical judgment.

#### Type of lesion

As previously stated, in the earlier period only patients with more fibrotic types of lesions were operated on. But the majority of the patients in the sanatorium had the exudative type, and since for many of these, other methods having failed, there seemed to be nothing left but to try a thoracoplasty. In table V we have grouped the

#### Cavity closure

One of the main objects of a thoracoplasty operation is to obtain a definite closure of cavities; all our cases, except seven, showed clear cavity shadows in the radiogram and by fluoroscopy before operation; the seven cases without demonstrable cavities had persistently positive sputum for years, and some had had repeated hæmoptysis; the cavities could perhaps have been found by tomography, a method not yet at our disposal. The cavities ranged in size from small ones less than 2.5 cm. to large ones of more than 7.5 cm. in diameter. In table VI we have grouped the cases according to whether the cavities were smaller or larger than 5 cm. in diameter.

From table VI it can be seen that, as would be expected, the smaller cavities are easier to close than the larger ones. In the group with cavities above 5 cm. in diameter are included six

TABLE V

*Thoracoplasty results compared with the type of pulmonary lesion*

| Type of lesion                 | Total | CLINICAL RESULTS |          |                     |                       |                | Sputum results |      |      |
|--------------------------------|-------|------------------|----------|---------------------|-----------------------|----------------|----------------|------|------|
|                                |       | Living           |          |                     | Died                  |                | O TB           | ± TB | + TB |
|                                |       | Much improved    | Improved | Stationary or worse | During first 2 months | After 2 months |                |      |      |
| Productive-fibrotic ..         | 55    | %                |          |                     | %                     |                | %              |      |      |
| Predominantly productive.      | 45    | 31 = 68.9        | 12       | 1                   | 6 = 13.3              | 5              | 24 = 53.3      | 2    | 18   |
| Predominantly fresh exudative. | 46    | 18 = 39.1        | 10       | 5                   | 6 = 13.0              | 6              | 16 = 34.8      | 2    | 15   |
| TOTAL ..                       | 146   | 67 = 45.9        | 34       | 10                  | 21 = 14.4             | 14             | 57 = 39.1      | 6    | 48   |

Note.—Four empyema cases excluded.

patients according to the radiological appearance of their lesions; in the group 'predominantly productive' we have included patients who, as far as we could judge, had a definite tendency to form more chronic productive lesions but this does not exclude the presence of some exudative elements. Similarly, in the group of more fresh exudative cases there will be lesions with some productive elements, as practically in all cases both elements coexist.

Although there is some difference in the results between the three groups, this is by no means very large; the difference is reflected less in the sputum figures than in the clinical results. On the other hand it may be said that our figures show that thoracoplasty treatment for cases with predominantly exudative lesions certainly is justifiable, provided, as stated above, that their general condition is good and the operation is timed at the proper phase in the evolution of the disease.

cases with cavities measuring more than 7.5 cm. in diameter, and we obtained definite closure with negative sputum in two. A result of 31.4 per cent TB-negative in all cases with cavities of 5 cm. or more in diameter is definitely encouraging.

It might be argued that perhaps some of the cases with cavities might have obtained cavity closure without thoracoplasty, especially those with small cavities. As we have from time to time observed such spontaneous healing of cavities, it is our practice not to do a thoracoplasty before we are convinced the cavities will not close by conservative methods.

On the other hand there are cases in which the cavities do not close even with thoracoplasty. In the group with cavities smaller than 5 cm. in diameter (table VI), there are 26.4 per cent who still had a positive sputum after the operation, and in most of them the positive sputum was due to non-closure of the cavity. It is not

TABLE VI

*Thoracoplasty results compared with size of cavity\**

| Cavity diameter  | Number of patients | CLINICAL RESULTS |                |                     |                       |                | Sputum results |              |                |
|------------------|--------------------|------------------|----------------|---------------------|-----------------------|----------------|----------------|--------------|----------------|
|                  |                    | Living           |                |                     | Died                  |                |                |              |                |
|                  |                    | Much improved    | Improved       | Stationary or worse | During first 2 months | After 2 months | O TB           | ± TB         | + TB           |
| Less than 5 cm.  | 87                 | %<br>45 = 51.7   | %<br>23 = 26.4 | %<br>1 = 1.2        | %<br>10 = 11.5        | %<br>8 = 9.2   | %<br>41 = 47.2 | %<br>5 = 5.7 | %<br>23 = 26.4 |
| 5 cm. or more .. | 35                 | 13 = 37.2        | 8 = 22.8       | 6 = 17.2            | 6 = 17.2              | 2 = 5.7        | 11 = 31.4      | 1 = 2.9      | 15 = 42.8      |
| TOTAL ..         | 122                | 58 = 47.6        | 31 = 25.8      | 7 = 5.7             | 16 = 13.1             | 10 = 8.2       | 52 = 42.7      | 6 = 4.9      | 38 = 31.2      |

\* Following 28 patients are omitted: 16 'Brauer-Friedrich' cases, 3 empyema cases, 2 incomplected cases and 7 cases without definite radiological cavity shadows.

easy to predict what sort of cavities may close. Sometimes cavities show a quicker and easier closure than expected, while in other cases in which no difficulties were anticipated, it was not possible to get the cavities closed in spite of the most radical removal of ribs. These cases present a most difficult problem, one which we have in common with other workers.

One of the reasons why the cavities do not close may be the removal of too few ribs. In table VII 96 living patients are grouped according to the number of ribs removed, the position of the cavity being taken into account.

TABLE VII

*The number of resected ribs in 96 thoracoplasty patients\* correlated with the position of the cavity as determined by the number of its nearest underlying rib (posterior end)*

| Difference between the number of the rib just below the cavity and the number of ribs resected | Patients remaining TB-positive | Patients rendered TB-negative |      |
|--|--------------------------------|-------------------------------|------|
|  |                                |                               | %    |
| - 5  | 1                              | 0                             | ..   |
| - 3  | 1                              | 0                             | ..   |
| - 2  | 0                              | 1                             | ..   |
| - 1  | 8                              | 5                             | 38.6 |
| 0  | 17                             | 18                            | 51.3 |
| + 1  | 13                             | 22                            | 62.8 |
| + 2  | 6                              | 4                             | ..   |
| + 3  | 0                              | 2                             | ..   |
| TOTAL ..   | 46                             | 52                            |      |

\* Following 52 patients are omitted: 16 'Brauer-Friedrich' cases, 3 empyema cases, 26 dead and 7 patients without definite radiological cavity shadows.

The figures (table VII) suggest that the best procedure to get the cavity closed is the removal of the ribs down to the one just below the cavity or the next lower rib. It is better to remove too many ribs than too few. Edwards, Leggat and Morriston Davies (1941) advocate as a matter of routine a ten-rib thoracoplasty regardless of the extent of the disease in the chronic type, and report very good results, but they suggest that a partial thoracoplasty may be preferable in cases they group as 'justifiable risk', the type of cases we most commonly find among our thoracoplasty patients. The partial thoracoplasty is in line with the modern principles of selective collapse, since it allows as much of the healthy lung as possible to function, thereby also reducing the strain on the contralateral lung which often shows some evidence of disease, either old or fresh.

Early regeneration of resected ribs may be another cause of failure in cavity closure. This is a consequence of the operation being done in stages. Therefore, it is important that the

TABLE VIII

*Length of interval between first and second stage in 98 living patients who had the modern type of thoracoplasty in two stages or more*

| Length of interval between 1st and 2nd stages | Patients rendered TB-negative (- TB) | Patients remaining TB-positive (+ TB) |
|---|--------------------------------------|---------------------------------------|
|   | %                                    | %                                     |
| Less than 6 weeks                             | 35 = 67.3                            | 20 = 43.5                             |
| 7 weeks or more                               | 17 = 32.7                            | 26 = 56.5                             |
| TOTAL ..                                      | 52 = 100                             | 46 = 100                              |

interval between the various stages should be as short as possible. That this is so may be seen from table VIII where the disappearance of

tubercle bacilli is considered in relation to the interval between the operations.

We have given only the length of interval between the first and second stages as in most cases it is the regrowth of the upper two or three ribs which prevents the cavity closure. Table VIII shows that the patients who became TB-negative generally had a shorter interval than those who remained TB-positive.

Another possible explanation of the failure of the cavities to close is the yielding of the mediastinum allowing the cavities to 'retreat' medially.

In other cases it may be that changes of a tuberculous origin in the wall of the draining bronchus may cause the bronchus to act as a check-valve to the cavity, allowing the air to be sucked in but preventing its escape. On the other hand, we have also obtained good results with cavities definitely inflated because of impeded bronchial drainage.

#### Other collapse measures

In 47 of the 150 cases, the thoracoplasty had been preceded by pneumothorax treatment on the same side for a period varying from some months to about a year. As the pneumothorax was contraselective and the sputum remained positive, it was abandoned in favour of a thoracoplasty; in some of the cases thoracoscopy had been tried but the adhesions were found uncauterizable. We find no appreciable difference in the results of thoracoplasty in this group compared with those who did not have a period of artificial pneumothorax treatment before the thoracoplasty.

whereas others have maintained that it is harmful. As our figures suggest that the operation has no influence on the results of subsequent thoracoplasty, we believe that a phrenic operation is unnecessary; moreover it goes against the principle of leaving as much as possible of the lung to function when the disease is confined to its upper part.

An extrapleural pneumothorax had been done in five patients but, as the result was not satisfactory, a thoracoplasty was done later, with a good result in four of the cases.

#### Thoracoplasty and contralateral disease

As will be seen from table X, over one-third of our cases operated on showed tuberculous changes in the contralateral lung, of varying degree. In some cases the lesions were of such a nature as to require collapse therapy. Five had pneumothorax treatment completed before the thoracoplasty on the other side, three had extrapleural pneumothorax and one a thoracoplasty; in fourteen the pneumothorax was kept up while the other side was operated upon. The results in bilateral cases are naturally less good than in the unilateral ones. They are, however, sufficiently encouraging for us to state that in many instances contralateral disease is not a contraindication if it is not too extensive and if it is amenable to collapse therapy.

#### Extrapleural complications

Twenty-one cases had laryngeal tuberculosis, diagnosed either by the symptoms or by routine

TABLE IX

*Phrenic nerve operation (paralysis hemidiaphragmatica) as a preliminary to thoracoplasty*

|   |                    | CLINICAL RESULTS |            |                     |                   |                                       |                | Sputum results |          |            |
|---|--------------------|------------------|------------|---------------------|-------------------|---------------------------------------|----------------|----------------|----------|------------|
|   |                    | Living           |            |                     | Died              |                                       |                |                |          |            |
|   | Number of patients | Much improved    | Improved   | Stationary or worse | Within first week | During 2nd week to 2 months inclusive | After 2 months | O TB           | ± TB     | + TB       |
| Diaphragm paralysed.                        | 43                 | 20 = 46.6%       | 7 = 16.3%  | 4 = 9.3%            | 3 = 6.9%          | 2 = 4.7%                              | 7 = 16.3%      | 17 = 39.5%     | 0%       | 14 = 32.6% |
| Controls (no phrenic nerve operation done). | 107                | 50 = 46.7%       | 27 = 25.2% | 6 = 5.6%            | 11 = 10.3%        | 5 = 4.7%                              | 8 = 7.5%       | 42 = 39.3%     | 6 = 5.6% | 35 = 32.7% |

In 43 patients a phrenic nerve operation had preceded the thoracoplasty. This group also showed no difference from the rest of the 150 patients who had no phrenic operation.

Phrenic nerve operation has been advocated by some as a useful preliminary to thoracoplasty,

laryngoscopy. These patients showed practically the same results as the rest.

Eleven patients had moderately severe intestinal tuberculosis, three fistula-in-ano and three ischio-rectal abscess; the results in these seventeen patients were not so good as in the

TABLE X.  
Condition of contra-lateral Lung  
Thoracoplasty patients with bilateral affection compared with unilateral cases

| Condition of 'better' lung                          | Total | CLINICAL RESULTS |           |                     |                       |                |           | Sputum results |           |      |
|---|-------|------------------|-----------|---------------------|-----------------------|----------------|-----------|----------------|-----------|------|
|   |       | Living           |           |                     | Died                  |                |           | - TB           | ± TB      | + TB |
|   |       | Much improved    | Improved  | Stationary or worse | During first 2 months | After 2 months |           |                |           |      |
|   |       | %                | %         | %                   | %                     | %              | %         | %              | %         | %    |
| <i>Bilaterally affected cases—</i>                  |       |                  |           |                     |                       |                |           |                |           |      |
| Minor changes, apparently inactive.                 | 16    | 4                | 6         | 1                   | 3                     | 2              | 5         | ..             | 6         |      |
| Moderate or probably active lesions.                | 16    | 6                | 3         | 1                   | 4                     | 2              | 6         | ..             | 4         |      |
| <i>Lesions requiring collapse treatment:</i>        |       |                  |           |                     |                       |                |           |                |           |      |
| (1) AP completed before the operation.              | 5     | 2                | 1         | 1                   | 1                     | ..             | 2         | ..             | 2         |      |
| (2) AP kept up during the thoracoplasty.            | 14    | 5                | 5         | 3                   | ..                    | 1              | 5         | 1              | 7         |      |
| (3) Patients having had extra-pleural pneumothorax. | 3     | 1                | ..        | ..                  | 2                     | ..             | ..        | ..             | 1         |      |
| (4) Previous thoracoplasty on better side.          | 1*    | ..               | ..        | ..                  | 1                     | ..             | ..        | ..             | ..        |      |
| Total ..  | 55    | 18 = 32.7        | 15 = 27.2 | 6 = 10.9            | 11 = 20.0             | 5 = 9.1        | 18 = 32.7 | 1 = 1.8        | 20 = 36.3 |      |
| <i>Unilateral cases—</i>                            |       |                  |           |                     |                       |                |           |                |           |      |
| Total ..  | 95    | 52 = 54.8        | 19 = 20.0 | 4 = 4.2             | 10 = 10.5             | 10 = 10.5      | 41 = 43.1 | 5 = 5.3        | 20 = 21.1 |      |

\* The patient died after a thoracoplasty on the left side, having previously had in another institution an incomplete thoracoplasty (three ribs only) for the right side.

other cases, but the number is too small to allow of any conclusions.

### Conclusion

In order to obtain an unbiased estimation of the value of thoracoplasty treatment, a control group should be provided consisting of at least 150 patients who have had conservative treatment only but were in all other respects similar to those of the treated group. This has not been possible, and here we find ourselves in the same difficulty as practically all other workers who attempt to assess the value of any treatment of tuberculosis, whether it be pneumothorax, sanocrysin or thoracoplasty. One possibility would be to compare the thoracoplasty patients with a group of similar patients selected from an earlier period before thoracoplasty was used in the institution, but developments specially in the x-ray and laboratory work have influenced the diagnosis and assessment so that the two groups are not comparable. Another possibility would be to select patients for thoracoplasty and then operate only on alternate ones and treat the others by conservative methods. This is obviously impossible as we cannot withhold a

form of treatment just in order to secure a control, when we believe that this treatment is of real value. Since the patients operated on had already had conservative treatment without effect, and since we have seen satisfactory results in a large proportion after operation, we are left in no doubt as to the value of the operation.

As a result of experience gained from this series of patients treated by thoracoplasty, and experience covering a number of years, we should like in conclusion to emphasize a few points.

When using thoracoplasty it should be remembered that this treatment is only an adjuvant and not the whole treatment itself, and that both before and after the operation, the patient has to be treated on the general lines accepted for the treatment of tuberculosis.

A successful thoracoplasty depends not merely on technical perfection in performing the operation, but also on proper selection of the case, choice of the time for the operation, and planning the operation for the particular individual. This means considerable experience in treating tuberculous patients and a wide knowledge of the disease.

PLATE XX  
THORACOPLASTY IN THE TREATMENT OF PULMONARY TUBERCULOSIS :  
BENJAMIN & FRIMODT-MÖLLER

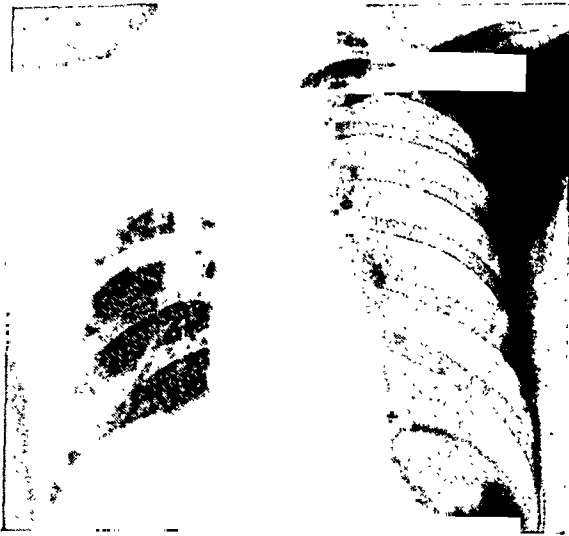


Fig. 1. Case 1.



Fig. 2. Case 1.

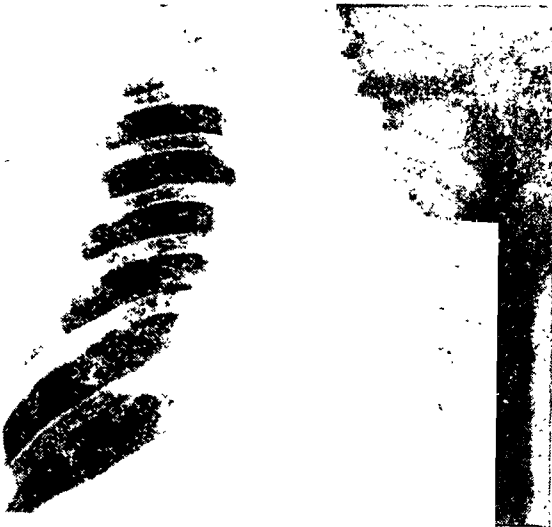


Fig. 3. Case 2.



Fig. 4. Case 2.

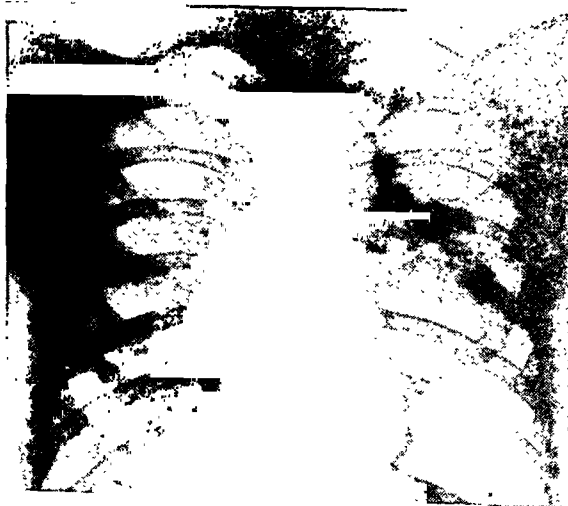


Fig. 5. Case 3.



PLATE XXI  
THORACOPLASTY IN THE TREATMENT OF PULMONARY TUBERCULOSIS :  
BENJAMIN & FRIMODT-MÖLLER

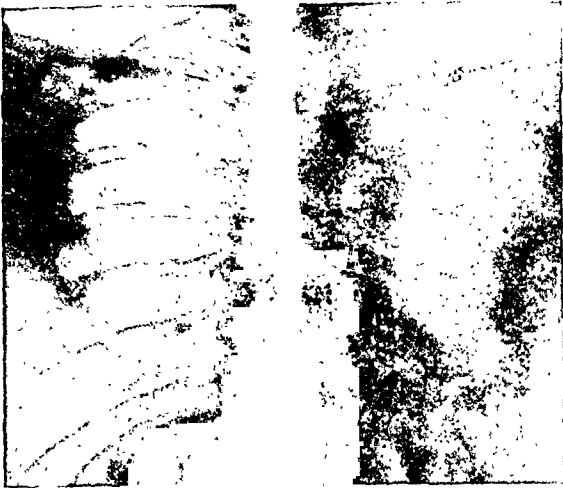


Fig. 6. Case 3.

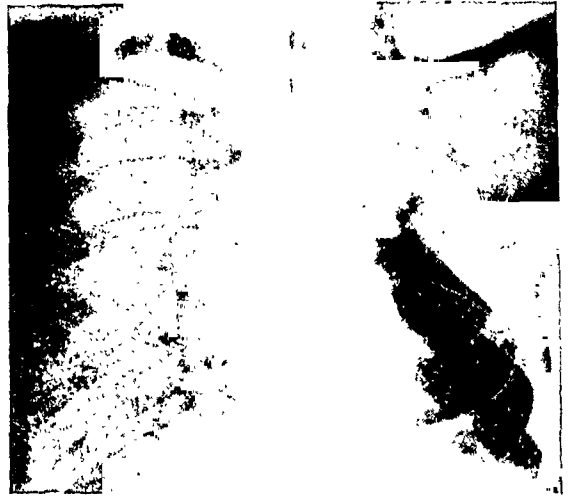


Fig. 7. Case 3.

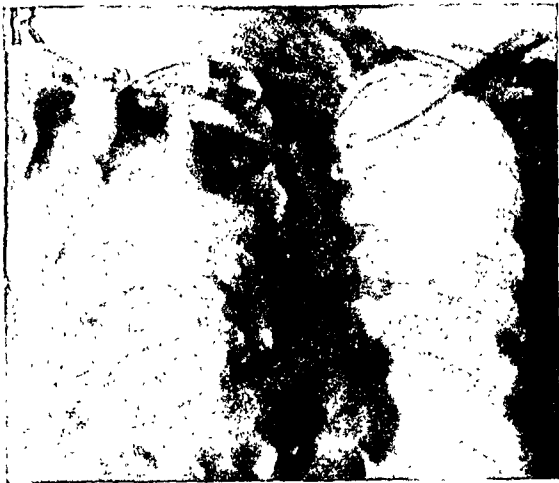


Fig. 8. Case 4.



Fig. 9. Case 4.

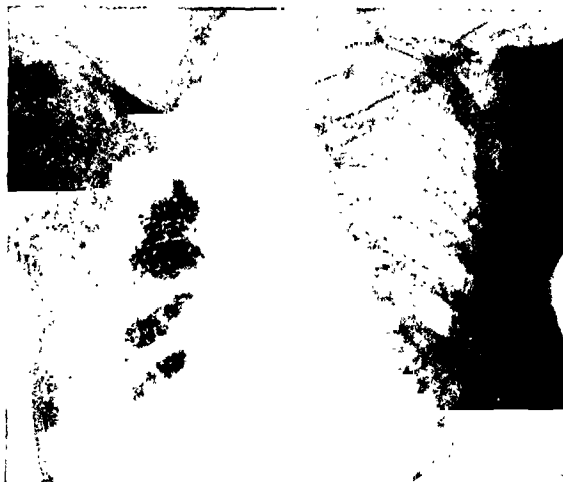


Fig. 10. Case 4.

The operation should be performed in a place which provides facilities for major surgery and a trained staff of doctors and nurses. It is not advisable to carry out this operation in a place where only a very occasional thoracoplasty can be done. Therefore it would be best if the operation was confined to certain selected centres where specialized staff and equipment are available. If closer co-operation between various institutions, sanatoria, hospitals and clinics can be developed, it would be possible for these central institutions to take over the patients needing the special treatment, while the other institutions took mainly patients requiring the simpler forms of treatment or patients who still needed supervision by specialists, after the operation. In such a way it would be possible to make thoracoplasty available to a much larger number of patients than at present, patients for whom this treatment will perhaps provide the only hope of recovery.

### Summary

(1) A series of 150 cases treated by thoracoplasty between 1932 and November 1941, the majority within the last three years, is analysed.

(2) Clinical results showed 46.7 per cent much improved and 22.7 per cent improved, a total of 69.4 per cent positive results.

(3) The sputum results showed 39.3 per cent cases with no tubercle bacilli.

(4) The operative mortality was 9.3 per cent for deaths within the first post-operative week, 14 per cent for deaths within the first two months.

(5) The results are examined with regard to age, sex, side operated on, general condition of the patient, blood examinations, type of lesion and size of cavities.

(6) Reasons for failure of cavities to close are discussed.

(7) Pneumothorax and phrenic operation preliminary to thoracoplasty showed no influence on the results.

(8) It is shown that contralateral disease need not be a contra-indication for thoracoplasty if the contralateral lesions are not too extensive or can be treated by collapse therapy.

(9) The need for closer co-operation between sanatoria, hospitals and clinics, and central institutions dealing with patients requiring thoracoplasty treatment is stressed.

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### Text to illustrations (figures 1 to 10)

*Case 1, figures 1 and 2.*—Mrs. A., married teacher, 29 years. Sick for 15 months: Upper half of right lung showed a process of predominantly productive type with a cavity, 2.4 × 4 cm. large, below right clavicle; trachea moderately displaced to right side (figure 1). Sputum + TB. Pneumothorax failed—thoracoplasty done in two stages, six ribs removed. Good selective collapse obtained with definite cavity closure (figure 2). Sputum became negative one month after last operation and remained negative the last four months before patient was discharged as much improved, fit for work.

*Case 2, figures 3 and 4.*—D. M. J., doctor, 39 years. Sick for 2 years and 4 months. Had previously been treated with pneumothorax on the left side for more than a year, developed effusion and a temporary empyema. Figure 3 shows left lung re-expanded but a huge cavity, 4 × 10 cm. large, remaining in left upper lobe; mediastinum displaced markedly to the left side. Sputum + TB. Had thoracoplasty in three stages, seven ribs removed. Collapse very good, cavity closed (figure 4). Sputum negative for more than two years after the operation, patient doing full work.

*Case 3, figures 5 to 7.*—Mr. D. D., 24 years. Ill for three years, had repeated hæmoptysis. Admitted with a contra-selective pneumothorax; left apex showed a large cavity (figure 5). As extensive adhesions were found uncauterizable at two thoracoscopies, the pneumothorax was stopped. When the lung had re-expanded, the cavity occupied the whole of left apex, measuring 3.5 × 5 cm., trachea pulled to the left (figure 6). Sputum + TB, advanced laryngeal tuberculosis. Thoracoplasty done in three posterior and one anterior stages, six ribs in all removed, resulting in a good collapse and cavity closure (figure 7). Sputum TB-negative for seven months. Patient much improved and fit for work; larynx healed.

*Case 4, figures 8 to 10.*—Miss I. B., 23 years. Had been treated here previously from October 1935 to January 1937 with pneumothorax for a fresh process with cavity in the right lung's upper lobe, pneumothorax continued another year at home, and patient was well with negative sputum until February 1941 when she got a relapse. Re-admitted May 1941, had now bilateral disease. Right lung: fairly chronic apical process with an infraclavicular cavity, 2.5 cm. in diameter, and in left lung, a fresh cavity at the centre. This fresh process was first treated with pneumothorax on the left side, supplemented with cauterization of adhesions. When the lesion in left lung appeared well under control, bacilli persisting, thoracoplasty was carried out for the right side after an attempt to re-induce artificial pneumothorax on this side had failed. Six ribs were removed on the right side through three posterior and one anterior stages (October 1941 to January 1942), the artificial pneumothorax on the left side being maintained at the same time. Figure 9 shows condition after second operation (four ribs removed), left lung partially collapsed by the artificial pneumothorax. Figure 10 shows condition on discharge on 23rd May, 1942. Right side, a good selective collapse, no cavity; left side, lung re-expanded, clear, and without cavity. Sputum was negative from January 1942 until discharge except for a single positive smear in May (classified under '± TB'). Patient much improved.

## THORACOPLASTY

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In America, as recently as fifteen years ago, surgery for tuberculosis of the lung was practically unknown, and was only occasionally used by a few pioneers. It is, therefore, not surprising that in Delhi thoracoplasty for tuberculosis of the lung has only just been inaugurated. I have examined very carefully all the records of the various hospitals in Delhi and have come to the conclusion that before 1940 no organized attempt was made to use thoracoplasty for treatment of tuberculosis of the lung. In January 1939 Lieut.-Colonel R. H. Candy (now Major-General Candy), the then chief medical officer, Delhi, created the post of honorary visiting surgeon in the Silver Jubilee Tuberculosis Hospital, Delhi, with a view to starting major surgical treatment for tuberculosis of the lung. On the strength of my apprenticeship to Professor Sauerbruch of Berlin and Professor Kunz of Vienna in the years 1935-37, Colonel Candy very kindly gave me the opportunity of starting this work.

In spite of an indifferently equipped operation theatre and the complete lack of any special instruments, I endeavoured to start the work with whatever I had at my disposal. It was more than a year before I was able to attempt my first thoracoplasty. My difficulties were an utter lack of surgical-mindedness among the public, and the failure of physicians in general to advocate surgery for tuberculosis of the lung, beyond the minor operations for collapse therapy.

Lieut.-Colonel M. M. Cruickshank, the present chief medical officer of Delhi, has taken a very keen interest in this matter and has procured all the special instruments necessary and, by his influence, has finally brought about the acceptance of major surgery by the leading tuberculosis specialists of Delhi. He also very kindly agreed to collaborate with me in all cases of thoracoplasty, and thus gave me the necessary encouragement to proceed with the work. We have so far done twenty-two cases since December 1940—all of them having been operated on in the Irwin Hospital. These cases were selected from patients of the New Delhi tuberculosis clinic, from sanatoria outside Delhi, from the Silver Jubilee Tuberculosis Hospital and from the Ramakrishna Mission clinic, the former two groups of patients being under Colonel Cruickshank, and the latter two under me.

The subject of collapse therapy is a very complex one and there should be perfect co-operation between the physician, the surgeon, and the roentgenologist. There is a paucity of competent thoracic surgeons in India, and the great distance between them and the rural sanatoria further handicaps thoracic surgery.

We in Delhi are general surgeons, performing thoracoplasties without adequate facilities for suitable pre-operative and post-operative care and management. We have to work without the aid of specially trained nurses and assistants, whose intimate acquaintance with tuberculosis, detailed knowledge of thoracic physiology and pathology and the special problems that arise in such cases, as well as a broad experience in the minute details of pre- and post-operative care of the phthisical patient are an essential addition to the equipment of a general hospital which undertakes the surgery of pulmonary tuberculosis. The margin of safety for the patient in our cases is therefore narrowed.

It appears to be the idea of some physicians that the ability to resect ribs and find the phrenic nerve is the foundation of thoracic surgery. I have seen well-known physicians undertaking surgery for collapse in which they clearly showed their fundamental lack of surgical training in their floundering technique and repeated violation of general surgical principles. It is true that it is possible for anyone with a little knowledge of anatomy and with brief or no surgical training, to find the phrenic nerve, but the number of serious, or even fatal, complications on record following this minor operation in the hands of unskilled operators is appalling. The small incision, for example, may meet an exceptionally large vessel, or the operation may at times become difficult and dangerous enough to require the utmost resourcefulness of an experienced surgeon.

The question of whether the operation of thoracoplasty should be undertaken in a sanatorium or in a general hospital is still a vexed one. American opinion seems to be unanimous that it is unjustifiable for a surgeon to perform a thoracoplasty in a sanatorium if he is unable to make daily visits to the patient during the important post-operative period.

In my opinion, although a surgeon dislikes to operate on a case which he is unable to follow closely, it is not essential for him to visit the patient daily if a suitably trained resident assistant is available.

The plan of transferring the patient to the general hospital has obvious disadvantages. These include problems of transport, the change of the patient to an unaccustomed environment, the lack of separate accommodation for open cases of pulmonary tuberculosis, and the use of attendants and nurses who are not trained in the regime of a sanatorium. A properly equipped sanatorium should, I believe, have on its visiting staff a surgeon who is able to visit the sanatorium as often as once a week for purposes of consultation and operation.

### *The evolution of thoracoplasty*

The study of the evolution of thoracoplasty is a very interesting one. In 1885 De Cernville of Lausanne first realized the need of breaking the continuity of the rigid thoracic wall in order

to collapse the lung effectively. The idea first occurred to him after studying the work of Simon (1869) and Estlander (1879) and his own work on empyema (1877). He performed four operations for apical tuberculosis where he removed 3.5 cm. of the 2nd and 3rd ribs, or as many ribs as necessary according to the extent of the cavity. This pioneer work is the beginning of the evolution of modern postero-lateral thoracoplasty operations. In 1888, and later in 1896, Quinke advocated small costal resections for cavernous and non-cavernous lesions. In 1890 Karl Spengle advocated the removal of greater lengths of rib through a para-scapular incision. Until 1903 Garre, Bier, and Landerer practised thoracoplasty but were dissatisfied with the resulting incomplete collapse. Brauer, in 1906, argued that clinical success could only be attained when the collapse of the lung affected by operation was similar to that attained by pneumothorax, and he felt the need of the removal of the entire length of the ribs from the 2nd to the 9th to obtain actual compression rather than mere relaxation.

Friedrich, on 17th December, 1907, undertook this heroic operation for him and performed it on M. Cordier who survived the operation and who, fourteen months later, was labelled as an arrested case. He performed the operation under a local anæsthetic, supplemented by a light general one. These two surgeons quickly improved their technique, and suggested a two-stage instead of a one-stage operation, sub-periosteal resection of ribs, the limited resection of the upper ribs to avoid flutter, and positive pressure breathing, and also suggested cough-resisting drugs. In 1911 Friedrich further modified this operation and performed the para-vertebral thoracoplasty. Brauer differed from Friedrich and developed his subscapular para-vertebral thoracoplasty. Wilms, of Heidelberg, in 1911 developed his own technique and included the 1st rib. Sauerbruch of Marburg, later of Zurich and Munich, and now of Berlin, devised in 1909 his famous operation of para-vertebral thoracoplasty, using a long vertical incision through the skin and muscles to the ribs. This was the first real para-vertebral operation ever performed for pulmonary tuberculosis. In the beginning he was not satisfied and used a variety of new operations, finally perfecting his technique in 1924. He insisted that the lower ribs should be first removed to prevent aspiration, and he initiated the two-stage operation as advocated, but not practised, by Brauer. It was he who first realized the importance and significance of the removal of the 1st rib, and declared in his unique manner that, whatever else is done, the 1st rib must be removed under all circumstances.

The modern operation consists of the removal of the postero-lateral parts of ribs and varying lengths of the anterior portions of the ribs in several, not one or two, operative stages. The majority of patients require the removal of

seven or eight ribs. Experience shows that Sauerbruch's and Brauer's operations left too much of the antero-lateral portion of the ribs. Alexander, of Michigan, perfected the modern postero-lateral operation in 1928 and began to remove still greater lengths of the upper ribs. O'Brien and Alexander showed that by the postero-lateral incision the costal cartilage, and even the sternum, can be removed. The modern operation involves the removal over the diseased lung of the transverse processes of the corresponding vertebræ as well as the ribs, the upper ribs being removed first.

### *Physiology of thoracoplasty*

The alteration of the physiology of respiration in collapse therapy takes place in two ways: firstly, by reduction in the size of the thoracic cavity and, secondly, by restricting the movement. With this reduction of the thoracic space there is a reduction in the pulmonary volume and increase in intra-pleural pressure similar to that of pneumothorax.

I have noticed that some authors use the terms atelectasis and collapse vaguely, confusing their readers. The pathogenesis of the two conditions are quite distinct and should not be confused with one another. Collapse is a mechanical diminution in the volume of air in the lung, while atelectasis is caused by occlusion of the arterial blood supply or the airways, followed by absorption of the air from the parenchyma. Atelectasis cannot be produced by external pressure, so that, if a lung becomes atelectatic after collapse therapy, then endobronchial obstruction or bronchial kinking should be suspected. It has been conclusively proved by extensive experiments carried out by Alexander, that the following pathological changes occur after collapse of the lung: (1) In the early stage a slight histiocytic reaction in the septa and in the perivascular and peribronchial spaces, terminating in slight increase of connective tissue. (2) Thickening of pleura to a slight degree without evident inflammatory changes, probably due to slowing of lymphatic flow. (3) Relative local anæmia. (4) Slight dilatation of lymphatics. (5) Alveolar cells may in part become cuboidal, resembling the embryonal state. (6) There is neither atelectasis nor diffuse fibrosis, this point being the most important one.

The outstanding effect on the tuberculous focus after collapse is, of course, fibrosis, which causes encapsulation of the diseased tissue, fibrotic organization of the lesion, and an increase of perivascular, peribronchial and septal connective tissue. The way in which healing takes place under collapse therapy is far from settled, but it is possible to enumerate the factors which contribute towards the process of healing. They are: (1) Elastic relaxation which eliminates strain on diseased tissue, thus enhancing scar contraction and collapse of cavities. (2) Relative or absolute rest secured by the decrease

in thoracic movements. (3) Actual compression of pulmonary tissue. (4) Restriction of respiratory amplitude, hindering bronchogenic spread. (5) Relative anæmia hinders blood-borne spread. (6) Lymph stasis diminishing toxæmia.

*Type of operation.*—It was my impression that, apart from the modern postero-lateral operations, other types of thoracoplasties are now obsolete, although as late as 1937 I saw Professor Sauerbruch in Berlin and Professor Kunz in Vienna performing the Wilms-Sauerbruch type of operation, beginning with the lower ribs and doing the whole operation in either one or two stages. They also removed the transverse processes of the corresponding vertebræ. The research carried on by Walter, Graf, Balle, and Alexander had improved the technique so greatly that the other types of operation were rendered obsolete. I was surprised to note that in the book *The Operations of Surgery*, published as late as 1936, Rowlands and Turner make no mention of the modern postero-lateral operation or the removal of the transverse processes, but, instead, give a detailed description of Sauerbruch's operation, the author stating: 'if the operation is performed in two stages the lower ribs, usually 5th to 11th, should be excised at the first operation, the upper 4th and 5th ribs at the second'. In *Post Graduate Surgery*, edited by Rodney Maingot and published in 1937, in which the chapter on thoracic surgery is contributed by Holmes Sellers, there is also no mention of Alexander's operation, neither is there any mention of the special instruments. He describes in great detail the total paravertebral operation in (1) single stage and (2) two or more stages, and remarks: 'only a short length of the 11th rib must be taken, if that rib is touched at all, and increasing lengths of ribs are removed until 6 to 8 inches are resected about the level of the 8th rib. From this point there is a reduction until at the 2nd or 3rd rib only 3 or 4 inches are excised'. Further, he says: 'It has been emphasized that rib must be removed as close to the transverse process as possible, and if a projecting stump is left, powerful punch forceps are used to remedy the defect...excision of transverse processes is sometimes practised to enhance the posterior collapse'. *Pulmonary Tuberculosis* by Kayne, Paget, and O'Shaughnessy, published in 1939, also recommends the paravertebral operation as the operation of choice, and further recommends the carrying out of the lower stage first—'in order to avoid the danger of aspiration...the extreme posterior end of the rib, up to, or even including, the tip of the transverse process, is excised'. This book, however, mentions the modern postero-lateral operation, but does not advocate its general adoption. I am not aware of the position in Great Britain to-day, but in America all operations, with the exception of the modern postero-lateral operation, are now regarded as

obsolete. In Calcutta, one surgeon is still doing the Sauerbruch type of operation, without removing the transverse process, but others are doing the modern postero-lateral type of operation. In the Madanapalli Centre also this is the type of operation performed. Mirajkar of Lahore usually removes the first seven or eight ribs, with their transverse processes, in one or two stages, and removes a large portion of the posterior angle of the scapula, after the American surgeons. We, however, have only done the modern postero-lateral type.

#### *The modern postero-lateral operation*

*The patient.*—Although the general condition of the patient should be the main consideration in determining whether a thoracoplasty can be performed with reasonable safety, we are faced with many problems, as already noted, the unwillingness on the part of the patient in general, in Delhi, to submit to a major operation being the chief handicap. Otherwise, the number of suitable patients in the Silver Jubilee Tuberculosis Hospital is enormous. It has been my practice to give to the patients a general picture of the whole operation and to explain to them that the chance of complete recovery is good, and then leave it to the patient to decide. I have been disappointed to find that the majority dread the operation so much that they choose instead an almost certain death from tuberculosis, which, because it is not immediate, is to a great extent unrealized.

On broad principles we prefer patients (1) who are in the third or fourth decade, although we have a case on our records of a boy of 6, on whom a thoracoplasty was done with excellent results; (2) as a rule we do not take cases unless the cardio-circulatory functional reserve is satisfactory. We are guided in this by the blood pressure readings and pulse and respiratory rates taken during strict rest, two to five minutes after mild exercise; (3) if the daily morning temperature on the chart shows a horizontal line, we consider this as a point in the patient's favour; and (4) we have so far selected only unilateral cases.

In conclusion we chose patients in a fairly good general condition, who have had no recent exacerbation of the disease, whose cardiac and respiratory reserves are adequate, and who are apparently unilateral cases whose lesion is predominantly cavernous and exudative in nature, and in whom other revocable operations have failed to arrest the lesion.

*Pre-operative management.*—I have already expressed the view that major surgery for pulmonary tuberculosis is best undertaken in a sanatorium which is equipped for the purpose. In order to emphasize the importance of suitable nursing facilities and the psychological effect of environment on the patient, I am repeating these points. As we transfer the patient to the Irwin Hospital we defer the operation for several days in order to give the patient rest,

both physical and mental, after his journey. Before the operation we take a fresh roentgenogram to verify the exact condition of both the lungs. We daily measure the amount of sputum for two reasons: (1) comparison with the post-operative amount, and (2) for guidance in the choice of anæsthetic. Carter has recommended routine digitalization of patients before operation and I have done it in two cases, but gave it up on the advice of our cardiologist, who was of the opinion that the digitalization of an essentially normal heart is more likely to be detrimental than beneficial. During the pre-operative resting period we carefully avoid increasing the patient's apprehension of the operation by telling him that the operation has been postponed on account of pressure of other work, so that he may not feel that extra precautions are being taken presumably because he presents a poor risk. The night before the operation a mild purgative is given. We do not as a rule give any sedative, but half an hour before the operation 1/6 gr. of morphia is given. A sedative might prevent free evacuation of sputum and atrophine makes the sputum sticky and difficult to expectorate, causing stasis of secretions. Finally, a few hours before operation the patient is advised to cough out as much sputum as possible, to procure an 'emptying of the lung'.

*Anæsthesia.*—Theoretically, the ideal anæsthetic should: (1) give a wide margin of safety; (2) be non-irritating to the lung; (3) be able to maintain quiet respiration and retain the cough reflex during complete analgesia; (4) allow a rapid recovery from narcosis in order to enable the patient to cough and expectorate voluntarily immediately after the operation; (5) not cause acidosis; and (6) not cause vomiting. Probably nitrous oxide and  $O_2$  come nearest to the ideal. Local and regional anæsthesia meet all the requirements. In America there is a preference for gas and  $O_2$ , but in the British Isles, chloroform, with or without local anæsthesia, was in favour at least until recently. On the Continent in general and in most clinics in India, local anæsthesia is preferred. Sauerbruch's anæsthetic of choice is ether. The general opinion to-day is that either chloroform or basal narcotics are more dangerous than gas or local anæsthesia, from the point of view of pulmonary complications.

Gas has the advantage of quick induction, and maintains the cough reflex. There is rapid recovery and other obvious advantages, but gas anæsthesia requires a preliminary opiate and frequently ether, or avertin, has to be added as anæsthesia cannot be maintained with gas alone without a dangerous degree of cyanosis. It requires a very skilled anæsthetist who can administer the correct proportion of gas and oxygen to maintain the cough reflexes and keep the patient quiet, and, at the same time, anæsthetize without sub-oxidation. Although we possess a very up-to-date gas and oxygen

apparatus we do not have, at present, the advantage of an anæsthetist highly experienced in gas and oxygen administration. Nitrous oxide further causes a large amount of fluid loss due to perspiration, and is often followed by vomiting. Ethylene has a very disagreeable odour and is highly inflammable. We have no experience of cyclopropane. Lastly, all gases are neither easily available nor sufficiently cheap for use on a large scale in India.

Theoretically, local anæsthetics should be an ideal form of anæsthesia. The greatest disadvantage in my opinion is that an operation of such magnitude as thoracoplasty is an insupportable ordeal for the average patient. I have done several major abdominal cases under local anæsthesia, but patients have invariably been faced with such a great psychological shock that from the very beginning I felt a great diffidence in using it for thoracoplasty. It is not always possible to produce a satisfactory anæsthesia with non-toxic amounts of the drug and it is also more difficult to produce for the subsequent postero-lateral stages, because of the difficulty of free dissemination of the solution. In the presence of extensive scarring it becomes quite impossible.

Although the fact that local anæsthesia demands extreme gentleness on the part of the surgeon might be considered an advantage, yet it does not permit of the rapid completion of the operation. Also, though the initial bleeding may be less, there is a greater tendency to bleed after the completion of the operation, on account of the passing off of the effect of adrenalin (if used) and the pressure of the injected fluid on the tissues.

The chances of poisoning, apart from individual susceptibility, are also great in the use of a local anæsthetic. In mild novocain poisoning there can be pallor, light cyanosis, a slow and then fast pulse, hiccough, and vomiting and this condition may be indistinguishable from surgical shock. There are sometimes delirium, collapse, and convulsions, due to small quantities of the local anæsthetic entering a vein or nerve sheath.

We, therefore, use pure ether, at times inducing with a little open ethyl chloride. I follow Sauerbruch in this respect and believe that ether has no unfavourable action on the lungs. We have used this anæsthetic in all our cases of thoracoplasty, and so far have never regretted it. Our anæsthetist is experienced enough to be able to maintain a slight cough reflex and at the same time produce a good anæsthesia. We have not had a single case of aspiration pneumonia, or any other post-operative pulmonary complication, even when the sputum was more than 30 c.cm. in 24 hours. We do not favour the induction of anæsthesia in an ante-room, but begin in the operation theatre, as this permits of the painting of the skin and draping of the patient before he is fully anæsthetized, thereby shortening the administration of the anæsthetic to the patient by five or ten minutes—which we believe to be of considerable importance to the patient. We keep



the patient at 15 to 20° Trendelenburg position throughout the operation, to assist the flow of the cavernous and bronchial secretions into the mouth by gravity, and so prevent their aspiration into the lung.

I have already said that the modern postero-lateral operation is the only operation done by us, because I consider the para-vertebral and other types of operation are nowadays, if not obsolete, at least rapidly becoming so. Statistics show that the best results in all respects are obtained by this type of operation, performed in two or more stages. We differ from Alexander and others in removing the first four ribs completely. This procedure does away with the risk of having to do a supplementary anterior thoracoplasty for incomplete closure. We have not, so far, regretted having taken this attitude. We remove the transverse processes as routine, and rarely remove more than three ribs at a time.

The modern operation is virtually the same in extent as the original Brauer-Friedrich operation, except that the former is performed with far greater safety in multiple stages and includes the removal of much greater lengths of the upper ribs as well as the transverse processes.

The dogmatic insistence of Sauerbruch, and others, resulted in the acceptance of removal of the lower ribs before the upper ones. They believe that the early collapse of the lower lung prevents aspiration from the diseased upper area to the lower area when the upper lung is collapsed later. Sauerbruch considers this point so important that he strongly opposes selective thoracoplasty of the upper ribs. The available evidence does not entirely justify Sauerbruch. Alexander studied this question and came to the conclusion that aspiration pneumonia can and does occur after the primary resection of the upper ribs, but the risk is considerably less than when the lower ribs are resected first. Aspiration pneumonia is rare in extra-pleural pneumolysis with paraffin filling. This is probably because the function of expectoration is very little impaired after operation. The abdominal muscles and the lower thoracic muscles are not interfered with, hence coughing is comparatively painless. There is no evidence to prove that a thoracoplastic collapse of the lungs prevents gravitation or even aspiration of secretion into the collapsed lung. It is probable that the bronchial secretions are frequently aspirated or they gravitate to the uninfected portion, but coughing and ciliary action removes them before they can do any damage. Interference, therefore, with the efficiency of coughing is the most important cause of aspiration pneumonia. The lower thoracic walls and the abdominal muscles play the most important rôle in the function of coughing and expectoration. The resection of the lower ribs in the first instance necessarily weakens the lower thoracic wall and makes the abdominal muscles painful. The abdominal muscles and the lower thoracic wall are not interfered with in the primary resection of the upper

ribs. The patient is unable to control the act of coughing so as to restrict it to one side of the chest, and the pain and paradoxical movements following a lower thoracoplasty tend to prevent efficient coughing. These facts together with the fact that the lung on the other side is somewhat more liable to inhale infectious secretions, account for the higher percentage of post-operative pneumonia in the uncollapsed lung. The importance of doing the upper ribs first in the presence of a large amount of secretion is more obvious. Further, it is more convenient to control the more extensive area first, which is usually in the upper lobe. The diminution in the amount of sputum following the first stage makes the more dangerous second stage safer. Finally, if the operation has to be suspended on account of unforeseen circumstances the performance of an upper first stage will have produced at least a partial effect. Nowadays it is rarely necessary to remove more than six, seven, or eight ribs. Incidentally it is no longer necessary to paralyse the diaphragm before starting a modern postero-lateral operation. The resection of the upper ribs collapses only that part of the lung which lies under those ribs, but when the resection of the lower ribs is performed, the upper ribs maintain a suspensory and hoop-like effect on the rest of the lung. And when, finally, the upper ribs are reached, there is a sudden great collapse of the whole lung, not only that portion of it immediately underlying the last resected rib, but of the more extensive portion that had been suspended and held open by the uppermost ribs. Consequently the patient is exposed to the danger of too sudden a collapse of a tuberculous lung.

The number of stages to be performed in a modern operation depends on the vertical extent of the lesion. Alexander has rarely removed more than six or seven ribs. In our experience, however, in almost all cases we had to remove nine ribs, excepting in one case out of twenty-one, in which we were satisfied with a six-rib resection. The reason probably is that our patients come to the surgeon a little too late. Alexander's usual procedure is two and a half, two and a half, and two ribs, whereas we resect three ribs at one stage. The extent of thoracoplasty to be performed is decided by us before undertaking the operation, and the apparent clinical arrest of the disease after having performed two stages does not deter us from performing the third stage. If we find that the lesion is sufficiently high to require the resection of only five or six ribs we usually do an eight-rib operation so that the lower end of the scapula will not remain posterior to the unresected ribs, because the permanent pulmonary collapse is much better when the entire scapula has fallen into the costal defect than when only the upper portion of the scapula has tilted into it. In such circumstances Mirajkar of Lahore resects the inferior end of the scapula which he believes causes

sudden pain by slipping over the upper end of the uppermost unresected rib. We have so far had no occasion to do a supplementary anterior thoracoplasty because, in order to avoid this possibility, we have removed the entire length of the first four or five ribs. Although Sauerbruch prefers a one-stage operation, I have seen him performing his operations in two or more stages. The chief advantage of multiple stages is that they unquestionably reduce the mortality as well as permit the removal of a greater length of rib, and consequently give a high percentage of closure of cavities.

We make an effort to keep the time interval between stages at three or four weeks but we are handicapped by various factors, chief amongst them being the reluctance of the patient to undergo the second stage at such a short interval. Our average interval has been six weeks, the minimum being three weeks and the maximum four months.

Modern thoracoplasty closes more than twice as many cavities as does the Wilms-Sauerbruch operation. This is entirely due to the removal of greater lengths of the ribs. If sufficiently great lengths of the ribs over the lesion are removed without too great a delay between the stages, few cavities resist closure. We do not deny that the para-vertebral operation does close a certain number of cavities, but decision as to the relative value of para-vertebral and the modern operation must depend upon the basis of the results in a large series of cases of both the types. The conclusion is inescapable that the surest way of producing a great collapse is by removing greater lengths rather than a greater number of ribs. Many textbooks emphasize the fact that the number of ribs resected and the length of a resection depend on the nature of the lesion. It is obvious that some cavities are more stiff-walled than others. It is true that soft-walled cavities will collapse by the removal of small portions of the ribs, but it is not possible clinically to assess entirely the degree of stiffness of the wall. Hence, while performing thoracoplasty, I believe that the maximum benefit should be offered to the patient by the removal of maximum lengths of rib. The risk in removing large portions of two or three ribs in one stage is very small. In the presence of very large cavities we remove not only the rib at the costochondrial junction, but also make an effort to remove bits of the cartilage of the first three ribs. We have, so far, not regretted having done so, and have come to the conclusion that the paradoxical movement is probably less after an extensive resection than after a limited resection because of the greater descent of the collapsed upper lung. Alexander has great fears about such a step by which the collapse is sudden and extensive. The mortality in cases where he has performed this technique has been very high and he has uttered a warning against the complete removal of the first four or five ribs, strongly advocating the performance of a supple-

mentary anterior thoracoplasty if required. In our series of twenty-one cases we have been fortunate in that we have not lost a single case after the first stage. We have, however, had three deaths out of the twenty-one cases in the second stage and have come to fear this stage.

We have procured for our thoracoplasty operations a few special instruments. We have Alexander's periosteum raspatories, square and round ended, Brewster's appendicectomy retractor for sacrospinalis muscle, a costotome, Sauerbruch's large square-nosed double-action rongeur, and a small rongeur.

*Operation.*—We place the patient on his side in 15° Trendelenburg, placing a rubber air ring beneath the patient's dependent shoulder to prevent the formation of a decubitus. The uppermost arm is hung over the edge of the table to assist in the forward displacement of the scapula. The dependent arm is thus anterior to the axis of the body preventing the patient's rolling forwards. We use sandbags instead of the Tudor Edwards anterior chest support. A strap is adjusted over the crest of the ileum tangentially to prevent the patient's sliding towards the head. The surgeon who makes the skin incision stands at the back of the patient and resects the costal end of the rib, while the first assistant performs the resection of the vertebral end including the transverse process. We have a second assistant to retract the sacrospinalis muscle. All our cases have been done by Colonel Cruickshank and myself together, the incision being made by the person under whose charge the case has been.

The incision is begun 5 cm. inferior and posterior to the anterior border of the trapezius muscle and is carried downwards several centimetres medial to the vertebral border of the scapula; it then curves laterally below the inferior angle of the scapula and is continued to the mid-axillary line. We incise the skin and the subcutaneous tissues and then identify the auscultatory triangle (figure 1). We consider it important to divide the entire thickness of the muscles at once, so that the immediate retraction of the muscles seals many of the small vessels. The larger vessels can be quickly clamped by two of the surgeons while the second assistant keeps on mopping. Carter has devised an excellent technique of dividing the muscle, but I have seen several surgeons performing thoracoplasty completely disregarding Carter's technique. (An incision that passes through only a part of the trapezius muscle at the first stroke of the scalpel is apt to result in so much bleeding as to invite the clamping of the vessels before the incision through the muscle is completed. The blood loss is enormous and the sight ghastly.) The surgeon and the assistant on the opposite side each introduces his index finger or thumb into the auscultatory triangle and then upwards between the ribs and the rhomboideus muscles. Each pinches the muscles between the forefinger and

thumb, or merely presses upwards with the forefinger while one of them divides the pinched section with scissors. Then each in turn clamps the large vessels whose position is indicated by

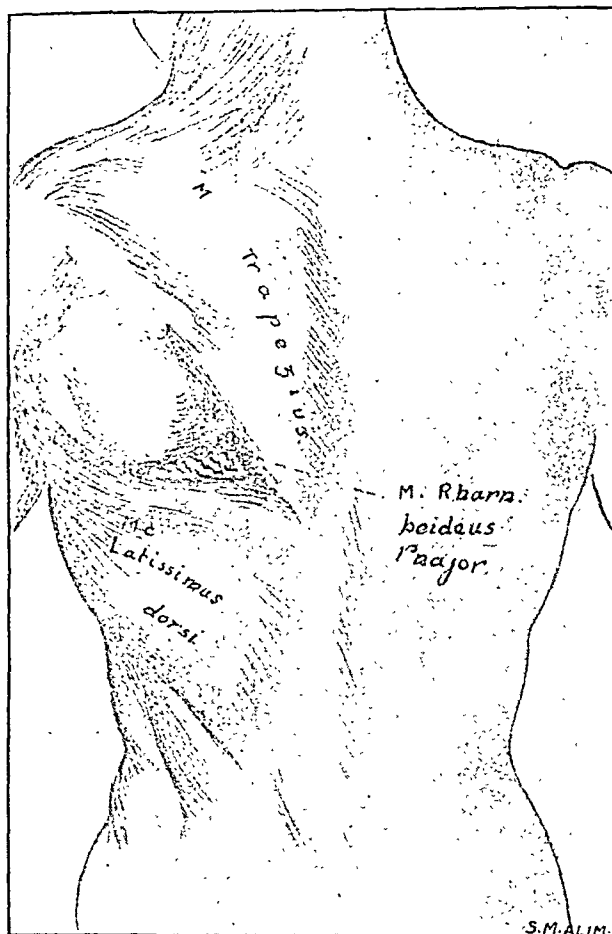


Fig. 1.—Showing the auscultatory triangle.



Fig. 2.—A. The surgeon and an assistant have introduced a forefinger and a thumb in the auscultatory triangle and then upwards deep to the rhomboideus major muscle.  
B. Showing the infra-lateral portion of the incision done in the same way.

(From Carter—Surgery, Gynecology and Obstetrics.)

the spurt of blood when the compression is momentarily relaxed. After the vessels have been secured, the fingers are advanced to the next section of the muscle (figure 2). The process is repeated until the vertical and curved sections have been completed. When we have had difficulty in finding the triangle, we have resorted to splitting the fat over the probable site and pushing the fingers through to reach the under surface of the muscle. I have seen some surgeons controlling the hæmorrhage by doubly clamping with long slender clamps section by section before dividing them, and at the end of the operation suturing the muscle over the clamps before removing them. Theoretically this is an excellent procedure, but the crushing of so much muscle invites infection and there is a greater danger of secondary hæmorrhage. After the skin and muscles are excised, the vessels ligated, and the skin towels placed, the vertebral border of the scapula is lifted posteriorly and laterally and the loose areolar tissue between the scapula and the ribs is divided by several sweeps of the fingers covered with gauze. The digitations of the origin of the serratus magnus are clearly visible upon the ribs. The digitation on the second rib is more posterior than the others and projects backwards as a crest when the scapula is retracted (figure 3). This crest serves as a

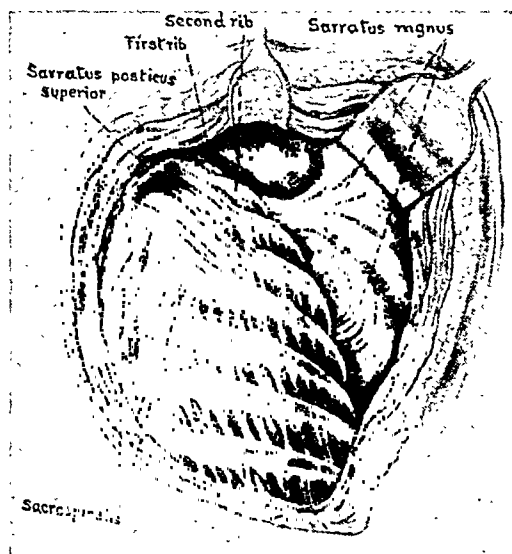


Fig. 3.—Digitation on second rib standing out as a crest when scapula is retracted.  
(From Alexander.)

convenient identification mark for the second rib. Beginning from the second digitation the muscle is raised from the upper five or six ribs. Care must be taken while separating the first digitation from the first rib to avoid danger to the brachial plexus and great vessels. We do not apply clamps on the divided edge of the muscle for fear of injury to the long thoracic nerve: we have found that hot mops are sufficient to stop hæmorrhage from one or two vessels in the muscle. The separation of the

serratus magnus origin has not so far interfered with the return of the function of the shoulder girdle in any of our cases, probably on account of the rapid adhesion of the muscle to the decostalized thoracic wall. We start by removing the second rib. In one of our cases we found the identification of the second rib difficult. In that case the radius of curvature of the first rib was simulating the second rib. We realized our error after we had seen the brachial plexus. The postero-lateral portion of the first rib has upper and lower surfaces and inner and outer borders, whereas all the other ribs have inner and outer surfaces and upper and lower borders. After removing the second rib, the removal of the first rib becomes easier. We remove the first rib after the second because of the possibility of having to suspend the operation after removing two ribs. If the third rib were removed before the first and the patient's subsequent condition did not permit the continuation of the operation, the first rib could, of course, be removed at a second operation, but its presence would interfere with the collapse between the operations. I believe that the first rib keeps the lungs suspended and expanded.

The subperiosteal resection of the ribs, excepting the first, is begun by separating the sacrospinalis muscle which extends to the costal angle. Retraction of the muscle is easier if the separation is carried two or three ribs above or below the rib to be resected.

We do not divide any perforating vessel from the intercostal space to the muscle medially to the tip of the transverse process, because the posterior rami of the thoracic nerves accompany them. The horizontal division of the sacrospinalis should be avoided because it leads to scoliosis. We strip the ribs bare of the periosteum with Alexander's periosteum raspatories. Then we divide a large central bit of the rib with the help of the costotome, after which the surgeon who is standing behind the patient frees the stump of the rib up to the sternum and removes it with or without the cartilage. The surgeon standing in front of the patient removes the posterior end and the transverse process. Here we have devised a technique which we consider very useful. With a pair of blunt-pointed curved scissors we deliberately divide the superior costo-transverse ligament on either side; then we divide the lateral and inferior costo-transverse ligaments. By this means we are able to depress the posterior end of the rib and then dislocate the whole rib together with the head by touches of scissors cutting the intra-articular ligaments (figures 4 and 5). This procedure exposes the under surface of the transverse process to view completely. Now the retraction of the sacrospinalis muscle exposes the transverse process in such a manner as to permit its complete removal under direct vision, by means of a Sauerbruch's rongeur (figure 6). Sometimes this procedure causes bleeding from the posterior external plexus of veins. This is

easily controlled by small hot mops. After dislocating the rib, if we find that the oozing from the posterior plexus is troublesome, we place a hot piece of mop at the site and postpone the removal of the transverse process till the next rib is removed, when the removal of the mop leaves a dry area.

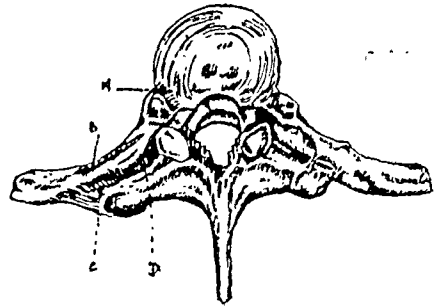


Fig. 4.—A. Infra-articular ligament.  
B. Superior costo-transverse ligament—cut.  
C. Lateral costo-transverse ligament.  
D. Inferior costo-transverse ligament.

The original method of removing the transverse process and the posterior end of the rib together with the rongeur has been found by us to be unsatisfactory. The transverse process has not been sufficiently removed and the head and part of the neck of the corresponding rib have been left behind, and the rongeur is used more

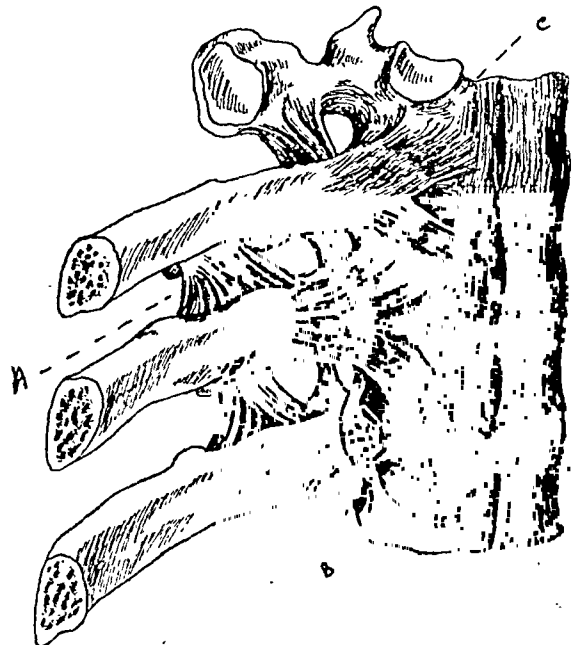


Fig. 5.—A. Superior costo-transverse ligament.  
B. Infra-articular ligament.  
C. Radiate ligament.

or less blindly (figure 7). We also make a point of removing the transverse process of the first rib because we dislike seeing the transverse process of the first rib standing out grotesquely in the x-ray picture. The first rib is more difficult and dangerous to remove. The first

step in freeing the first rib is to push off the periosteum and muscles from the outer border of the rib. The abducted position of the arm carries the brachial plexus and great vessels away from the upper surface, but they are in

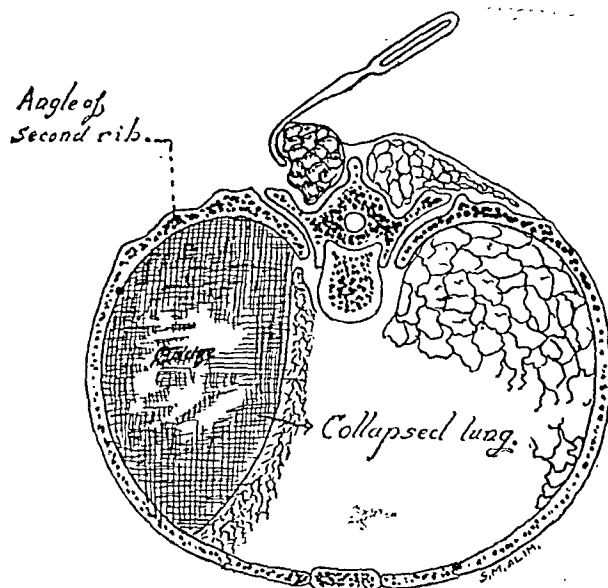


Fig. 6.—Showing how when the rib is disarticulated from the articular surface, the transverse process becomes visible.

danger of being injured where they cross the inner border. When the upper border is being freed, if the index finger is placed under the lower surface of the rib so that the tip of the finger lies against the inner border, the danger

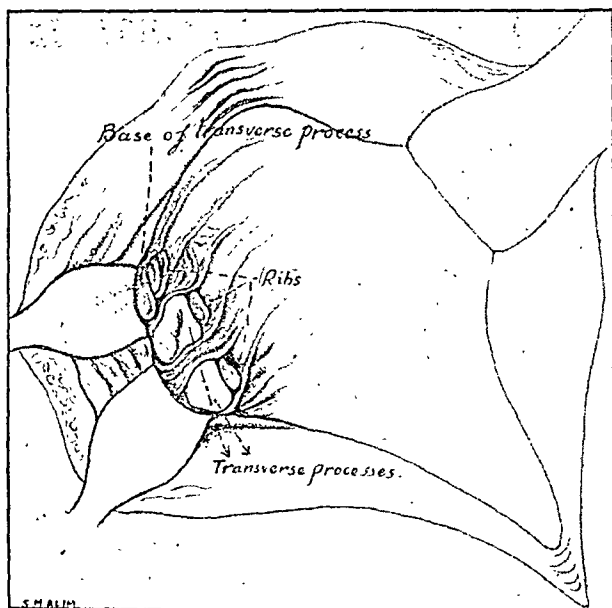


Fig. 7.—When the rib is not disarticulated the head, a portion of the neck and a portion of transverse processes are left behind.

of the instruments plunging over the inner border and injuring the vessels and nerves or the pleura is prevented. The end of the instrument and the tip of the finger should be held

close against one another, while the former rapidly separates the Sibson's fascia and muscular attachments. When the rib has been freed, the cartilage is divided with a costotome and the rib is removed. Then the extreme anterior end of the cartilage is removed with rongeurs, leaving only a little piece of the cartilage beneath the sterno-clavicular joint.

After the rib and transverse processes have been resected, the muscles are closed in one layer with continuous or interrupted catgut, and the skin is closed with interrupted silkworm gut. We insert a long drainage tube for thirty-six hours. A voluminous dressing is placed over the wound and bandaged in position. We fix the arm to the side because in our first case there was some gaping of the wound due to sudden violent movements by the patient. The weather conditions in Delhi, especially in summer, do not permit vaseline dressing or elaborate elastoplast. We perform the second stage through the same incision after excising the scar of the first operation. We sometimes do the third stage through the lower three-fourth of the same incision, but usually prefer a separate incision.

**Post-operative management.**—The surgeon who undertakes to perform a thoracoplasty assumes the heavy responsibility of supervising the entire post-operative care. There are few operations which demand as much expenditure of the time and attention to detail as does thoracoplasty for phthisis. In the absence of a trained team of nurses, I delegate to my house surgeon the constant attendance upon the patient during the first day and night after each stage and I tell the nurse to help him if the patient vomits. As soon as the patient is returned to the ward, I give either  $\text{CO}_2$  inhalation for five minutes every hour or make the patient inhale smelling salts until he comes round. As the patient comes round the nurse is instructed to stand by him and insist upon his coughing and expectorating at frequent intervals. She assists in this at hourly intervals by gently and firmly pressing with her open hand on the antero-lateral portion of the decostalized segment during coughing. She should wipe away the sputum from the lips rather than have him expectorate into a cup. Warm sodium bicarbonate solution or lemonade, or the inhalation of steam helps to raise tenacious sputum. Coughing is best encouraged by insisting upon the taking of several deep breaths. To assist this, hourly  $\text{CO}_2$  inhalations for five minutes are useful. Atropine is not given as a routine, but if the sputum is too abundant atropine may be given. Morphia or omnopon is useful when the cough reflex is present, but painful. We record the pulse rate and systolic and diastolic blood pressures every fifteen minutes during the first hour, every thirty minutes during the next two hours, and three-hourly during the next forty-eight hours. External heat is applied if the patient's rectal temperature is below  $97^\circ$ . We



Fig. 1.

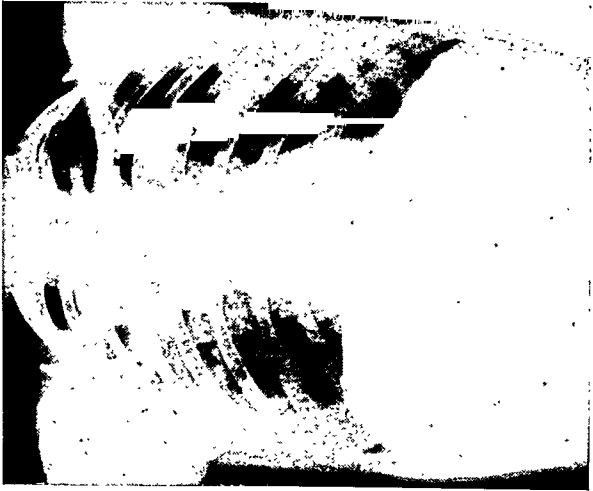


Fig. 2.



Figures 1, 2, 3 and 4 showing types of cases with operated on tackled by us.



Fig. 4

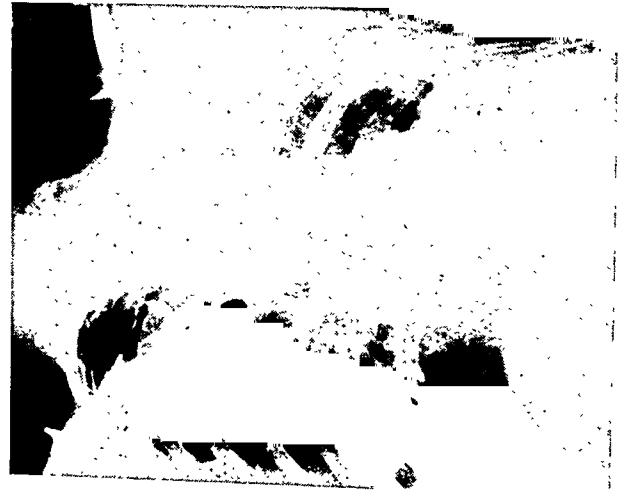


Fig. 5.—Case 9. B. R. After first stage. Three ribs removed.

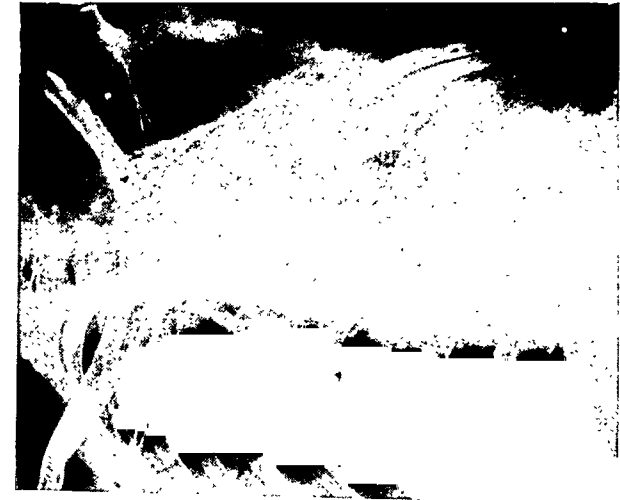


Fig. 6.—Case 9. B. R. After second stage. Six ribs removed.



Fig. 7.—Case 9. B. R. After third stage. Ten ribs removed.

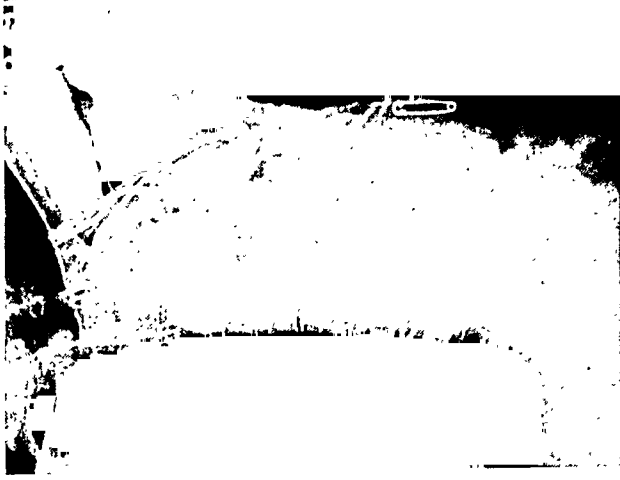


Fig. 8.—Case 9. B. R. After third stage. Ten ribs removed. Two days before discharge from observation.



PLATE XXIII  
THORACOPLASTY : S. K. SEN



Fig. 9.—Case 6. R. S. Before operation.



Fig. 10.—Case 6. R. S. After first stage.  
Three ribs removed.

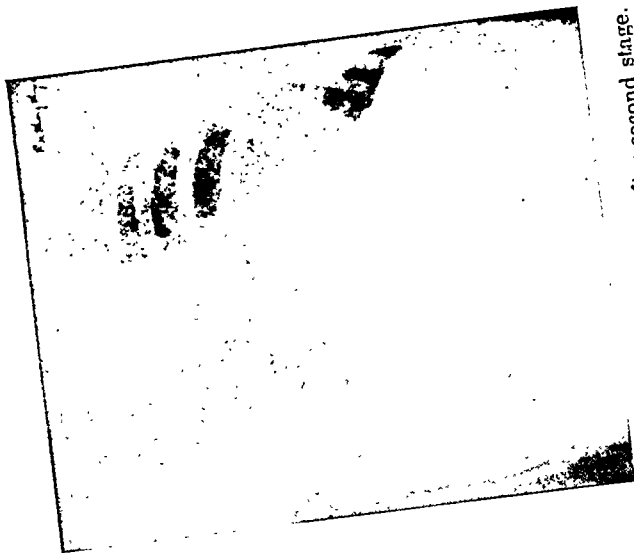


Fig. 11.—Case 6. R. S. After second stage.  
Six ribs removed. Refused third stage.  
Snapping scapula.

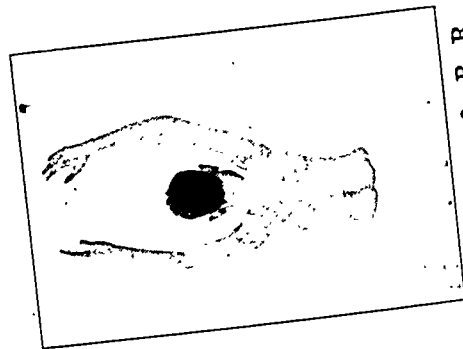


Fig. 12.—Case 9. B. R.  
After first stage.

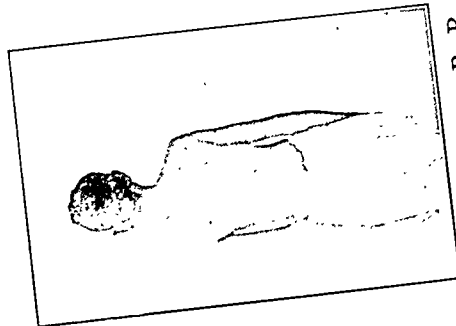


Fig. 13.—Case 9. B. R.  
Arms hanging by the  
side after second stage.  
Three-stage—ten-rib operation.

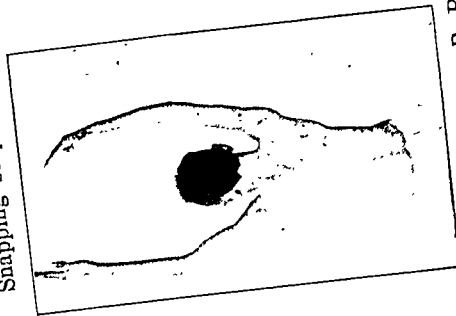


Fig. 14.—Case 9. B. R.  
After third stage.

begin intravenous saline in the operation theatre and continue it in the ward until 3,000 c.cm. are given in six hours. We use 5 per cent glucose saline. As the nausea disappears small amounts of water, fruit juice or weak tea are given at fifteen-minute intervals. If rectal fluid is to be given we prefer tap water. An enema is given three days after the operation and a solid diet of high calorific value is started as soon as the patient is able to take it.

The patient is returned from the theatre on his own bed of which the foot is raised 40 cm. to combat low blood pressure or prevent stasis of secretions. The foot of the bed is kept raised until the condition of the pulse and blood pressure is wholly satisfactory, and until the patient is able to expectorate freely, i.e., for the first two or three days. The head of the bed is not raised, the only exception being when the patient is dyspnoic. If the patient is tired of lying flat on his back he may be allowed to turn on the side operated on twenty-four hours after the operation, but not on the sound side for a week, for the reason that the secretion would gravitate into the sound lung. I place a sandbag on the side of operation below the clavicle, to increase the collapse (after 24 hours) and to control paradoxical movements. If paradoxical movement is present from the beginning a 2-lb. bag is placed in position immediately after the operation. If symptoms of early shock appear, the foot of the bed should be further raised and an injection of ephedrine and morphia given. It is best to continue the intravenous saline or gum acacia solution. Transfusion of whole blood or serum is given if necessary. To combat severe paradoxical movement and mediastinal flutter, inhalation of oxygen is useful, although in Sauerbruch's opinion positive pressure breathing is the only suitable treatment. Oxygen by funnel is considered useless. It should be given by intranasal catheter at 4 to 8 litres per minute. It is surprising how slight the post-operative pain is. Pain is only experienced during coughing and this can be lessened by the nurse's aid. It can be controlled by omnopon or morphia, but a too frequent use of morphia is to be avoided as it abolishes the cough reflex. If the patient complains of pain, the loosening or tightening of the bandage, or the direct inspection of the wound for the presence of a stiff suture sticking out, or of a too-tight skin suture, and attention to them will often alleviate pain. Pain in the arm in one of our cases was very severe, probably on account of injury to the first thoracic nerve, but it disappeared, without any ulnar paralysis.

Complications are dyspnoea, auto-tuberculinization, hiccough, and vomiting. Dyspnoea is best controlled with oxygen, hiccough is usually stopped by CO<sub>2</sub>, and vomiting is best treated by giving no fluids by mouth and adding sodium chloride to the intravenous transfusion fluid.

For some time after the thoracoplasty, a patient requires a support for the thoracic wall

which has been extensively decostalized, but he must be made to understand that the support is only a temporary one. Otherwise I have seen patients wearing the support for months together, for they are usually reluctant to discard the chest support. The brace should be discarded when after its removal there is no increase in sputum, no rales and no appearance of fever. We have used a modification of Woodruff's brace.

The surgical supervision of the patient is begun by us a few days before the operation when we transfer the cases from the various institutions into our wards. We continue to maintain charge of the patient until two or three weeks after the last stage has been performed. Between stages I send my patients back to the Silver Jubilee Tuberculosis Hospital or the Rama-krishna Mission Clinic after removal of the stitches, but the cases that come from outside Delhi are kept in the hospital until all the stages have been finished. When patients are sent back after a stage they still remain under my supervision. The period of sanatorium supervision is decided by the physician.

It is surprising how slight is the visible change which occurs in the shape of the thorax after such extensive decostalization. There are depressions above and below the clavicle, the scapula is less prominent, the shoulder is probably a little higher than the normal side, and one or two long scars are visible in the back. There is usually a slight upper thoracic scoliosis (figure 8), but if the patient is clothed, it is often difficult to tell upon which side the operation has been performed. In one of our cases we encountered 'snapping scapula' because the patient refused further operation after having undergone a two-stage six-rib resection. He has merely a disagreeable sensation of jumping of the scapula. The full range of movement of the shoulder joint has always been maintained in all our cases.

We have so far completed thoracoplasty operation in only 21 cases for tuberculosis of the lung and one Schede's thoracoplasty has been performed by us for tuberculous empyema. The latter patient died from shock after the operation. Out of our 21 cases there have been three deaths—a mortality rate of 14.25 per cent. All the three deaths occurred after the second stage. Two of them, both men, came from outside Delhi and were not under our observation for a sufficiently long time before the operation. The third case was a woman, suffering from Jacksonian epilepsy for which no cause could be found. She stood the first stage very well, although she had several fits in the ward. We were much encouraged by this and performed the second stage after four weeks. She had no post-operative paradoxical movements, nor was the shock too severe. On the eighth day, about an hour after the stitches had been removed, she went into a fit and never recovered from it. No post mortem could be performed as the relatives did not give us the necessary permission. One

case, as already mentioned, refused a third stage and his sputum is still positive and the cavity did not collapse sufficiently, although he apparently is better as his temperature never rises above 99.4°F. and he has less sputum.

Seventeen of our cases show no bacilli in the sputum and are afebrile; also the E. S. rates are considerably diminished. Eight of them

### Acknowledgments

I wish to express my gratitude to Colonel Cruickshank who has given me whole-hearted encouragement and help and has collaborated with me in all the cases. My thanks are also due to Dr. R. Krishna, internist at the Silver Jubilee Tuberculosis Hospital, Dr. A. Roy Chowdhry of the Ramakrishna Mission and

### Chart of our results

| Serial number | Name and age        | Lesion                      | Sputum ESR (1 hour) | Treatment          | I stage              | Sputum ESR | II stage           | Sputum ESR | III stage          | REMARKS                                  |
|---------------|---------------------|-----------------------------|---------------------|--------------------|----------------------|------------|--------------------|------------|--------------------|--|
| 1             | N. L. M., 38, H. M. | T.B. empyema.               | ..                  | ..                 | Schede thoracoplasty |            |                    | ..         | 9-12-40            | Death.                                   |
| 2             | S. H., 53, M. M.    | Cavity left middle.         | ++ 62               | AP failed phrenic. | 12-3-41 (3 ribs).    | + 48       | 17-4-41 (3 ribs).  | - ve       | ..                 | Died 6-5-41.                             |
| 3             | R. R., 21, H. F.    | Apex and middle right side. | ++ 48               | Gold and AP.       | 14-4-41 (3 ribs).    | ++ 50      | 28-5-41 (3 ribs).  | - ve 22    | 15-6-41 (2 ribs).  | Arrested, returned to home work, ESR—18. |
| 4             | B. S., 18, H. M.    | Apex                        | ++ 40               | Gold and AP.       | 1-5-41 (3 ribs).     | + 40       | 15-8-41 (3 ribs).  | - ve 24    | Not done           | Arrested, sent to sanatorium.            |
| 5             | S. B., 27, H. F.    | Apex and mid zone.          | ++ 42               | Gold               | 12-5-41 (3 ribs).    | - ve 38    | 5-7-41 (3 ribs).   | - ve 36    | 10-8-41 (2 ribs).  | Arrested, returned to work.              |
| 6             | R. S., 32, H. M.    | Apex and mid zone.          | ++ 48               | Gold and AP.       | 20-5-41 (3 ribs).    | + 40       | 5-7-41 (3 ribs).   | - ve 36    | Refused            | Cavity still open.                       |
| 7             | H. A., 27, H. F.    | Apex                        | ++ 42               | AP                 | 3-6-41 (3 ribs).     | + 40       | 10-7-41 (5 ribs).  | - ve 32    | ..                 | Arrested.                                |
| 8             | R. P., 30, H. M.    | Apex                        | ++ 50               | AP and gold.       | 2-6-41 (3 ribs).     | + 27       | 28-8-41 (3 ribs).  | - ve 21    | ..                 | Arrested, returned to work.              |
| 9             | B. R., 31, H. M.    | Apex and middle.            | ++ 68               | AP phrenic gold.   | 24-6-41 (3 ribs).    | + 38       | 8-10-41 (3 ribs).  | - ve 38    | 17-1-42 (4 ribs).  | Arrested, returned to work, ESR—11.      |
| 10            | A. M., 25, M. M.    | Apex                        | ++ 44               | AP                 | 17-7-41 (3 ribs).    | + 40       | 8-10-41 (3 ribs).  | - ve 36    | 19-12-41 (2 ribs). | Arrested, ESR—30 under observation.      |
| 11            | B. S., 18, H. M.    | Apex                        | ++ 42               | AP                 | 16-8-41 (3 ribs).    | + 38       | 20-8-41 (3 ribs).  | + ve 30    | 4-11-41 (2 ribs).  | Arrested, sent to sanatorium.            |
| 12            | A. R., 31, H. M.    | Apex                        | ++ 50               | AP                 | 8-9-41 (3 ribs).     | + 40       | 10-11-41 (3 ribs). | - ve 36    | Not done           | Arrested, under observation.             |
| 13            | S. L., 24, H. M.    | Apex and mid zone.          | ++ 38               | AP and gold.       | 18-9-41 (3 ribs).    | + 36       | 25-12-41 (3 ribs). | - ve 30    | 6-3-42 (2 ribs).   | Arrested, returned to work.              |
| 14            | P. D., 18, H. F.    | Apex                        | ++ 45               | AP                 | 2-10-41 (3 ribs).    | + 40       | 28-11-41 (3 ribs). | - ve 36    | 28-12-41 (2 ribs). | Arrested, returned to work.              |
| 15            | V. D., 21, H. M.    | Apex and middle.            | ++ 45               | AP and gold.       | 18-11-41 (3 ribs).   | + 55       | 17-1-42            | + 55       | ..                 | Died (21-1-42).                          |
| 16            | R., 28, H. F.       | Apex                        | ++ 40               | AP                 | 19-11-41 (3 ribs).   | + 36       | 28-12-41 (2 ribs). | - ve 18    | Not done           | Arrested, working.                       |
| 17            | R. D., 31, H. F.    | Apex                        | ++ 34               | AP                 | 9-9-41 (3 ribs).     | - ve 21    | 18-3-42 (3 ribs).  | - ve       | ..                 | Died on 26-3-42 (states epilepticus).    |
| 18            | B. C., 6, H. M.     | Apex                        | ++ 20               | AP                 | 9-9-41 (3 ribs).     | - ve 16    | ..                 | ..         | ..                 | Arrested.                                |
| 19            | R. R., 25, H. F.    | Apex and mid zone.          | ++ 30               | AP                 | 19-9-41 (3 ribs).    | - ve 25    | 20-11-41 (3 ribs). | - ve 20    | ..                 | Arrested, under observation.             |
| 20            | A. D., 31, H. M.    | Apex                        | ++ 42               | AP                 | 26-9-41 (3 ribs).    | - ve 36    | 28-11-41 (3 ribs). | - ve 30    | 17-1-42 (2 ribs).  | Arrested, under observation.             |
| 21            | R. L., 30, H. M.    | Apex                        | ++ 40               | AP and gold.       | 10-10-41 (3 ribs).   | - ve 30    | 28-12-41 (3 ribs). | - ve 30    | ..                 | Arrested.                                |
| 22            | K. C., 25, H. M.    | Apex and mid zone.          | ++ 28               | AP                 | 18-10-41 (3 ribs).   | - ve 25    | 28-12-41 (3 ribs). | - ve 20    | 14-2-42 (2 ribs).  | Arrested.                                |

have returned to their daily routine of life and are earning a livelihood or doing housework. Although the remaining nine cases have been allowed to go home as arrested cases, they are still under our observation as the E. S. rates are higher than normal and expectoration is still present. They have been advised not to start work yet. The eight 'cured' cases visit us once in three months.

Dr. Sikand of the New Delhi Tuberculosis Clinic for their constant advice and co-operation in selecting cases and persuading them to undergo the operation. My thanks are also due to my past and present house surgeons who have been of such great assistance to me. I also express my special gratitude to my wife, Dr. Sita Sen, who has kept all my records, arranged them for me and helped me in preparing this paper.

# BILATERAL THORACOPLASTY : REPORT ON 10 PATIENTS TREATED IN THE WANLESS TUBERCULOSIS SANATORIUM

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Medical Superintendent, Wanless Tuberculosis Sanatorium, Wanlesswadi, District Satara

THE efficiency of thoracoplasty in the treatment of pulmonary tuberculosis is universally admitted today. This surgical treatment of bilateral caseo-pneumonic affection with cavitation and with much fibrotic changes in the lesion situated in the apical and sub-clavicular region was done by Graveson as far back as 1931. Since then several European thoracic surgeons have done bilateral thoracoplasty. In the year 1936, Coryllos and Ornstein gave an illustrated report on 7 bilateral thoracoplasty cases done in Sea View Hospital.

Ten such patients were treated by bilateral thoracoplasty in the Wanless Tuberculosis Sanatorium during 1938 to 1941, a period of three years.

In all cases a fair trial of artificial pneumothorax treatment was given. In most of the cases artificial pneumothorax could not be induced and in some it was contra-selective. All cases were operated on with the procedure of paravertebral extra-pleural thoracoplasty as described by Sauerbruch and O'Shaughnessy (1937) with slight changes. The ribs generally resected at the first stage were, first, second and third; in the second stage fourth and fifth and in the third stage, the anterior stumps of first, second and third ribs by anterior appearance. In all these cases the operation was done under local anaesthetic. Half per cent procaine was used and a basal anaesthesia with morphine and atropine and, in certain cases, nembutol. There are several advantages in performing the operation under local anaesthetic. One of them is that there is a good co-operation between the patient and the surgeon. If the patient feels dyspnoic due to mediastinal flutter (if the rigidity of mediastinum is not sufficient which happens in some cases) or respiratory embarrassment, the surgeon is informed of these symptoms and uses his discretion and stops the operation for the time being, continuing after an interval of three weeks to a month. Hence, sometimes the resection of only one rib is done, sometimes two; sometimes the ribs are resected as far as the midaxillary line, sometimes only a few inches are removed. Another advantage of this procedure is that post-operative complications, such as excessive vomiting, aspiration-pneumonia and non-tuberculous broncho-pneumonia, can possibly be avoided.

The interval between the thoracoplasty on one side and on the other is three to six months and the interval between the stages is three weeks to six weeks.

The following indications and contra-indications were strictly followed.

## Indications :—

1. Bilateral apical and sub-clavicular infiltration with much productive element in the lesion.
2. Good respiratory reserve.
3. The general condition of the patient both physical and mental is good.

## Contra-indications :—

1. Exudative lesions without much productive element.
2. Vital capacity decidedly low, below 1,000 c.cm.
3. Respiratory embarrassment even during moderate exercise.
4. If the cavities are inferior to the level of the posterior ends of the 4th or 5th ribs.
5. Extra-pulmonary focus of infection in kidneys, and gastro-intestinal tract.
6. Valvular disease of the heart.
7. Myocarditis.

The following five illustrated cases are given :—

*Case 1.*—Female, aged 36 years, was admitted on 12th July, 1940, for bilateral caseo-pneumonic infiltration with much fibrosis, the apices and sub-clavicular regions being affected. Artificial pneumothorax was tried on both sides but failed due to thickened pleura. Therefore, first stage posterior paravertebral extra-pleural thoracoplasty operation was performed on the left side on 18th July with resection of first, second, and third ribs. After an interval of nearly three months and a half, first stage thoracoplasty operation on the right side was performed, with resection of first, second and third ribs with good collapse of lung. The patient was discharged in an excellent state of health as an arrested case. (Arrested according to the report of the sub-committee on classification of tuberculosis 1941.)

*Case 2.*—Male, aged 24 years, was admitted on 3rd August, 1938, with bilateral caseo-pneumonic affection with much fibrotic changes on both apices. Artificial pneumothorax was tried on the left side but failed; artificial pneumothorax on the right side was tried and was successful, and the patient had selective artificial pneumothorax. When his general condition improved after nearly six months, left side thoracoplasty operation was done on 29th April, 1939. The patient was discharged as a much improved case with good selective artificial pneumothorax on the right side and a negative sputum. The patient promised to continue his right artificial pneumothorax after discharge from the sanatorium. He was readmitted on 2nd May, 1941, with a positive sputum. He did not continue his artificial pneumothorax and the cavity reopened on the right apex. Artificial pneumothorax could not be induced again, therefore, first stage thoracoplasty on the right side was done resecting first, second and third ribs. The patient did very well and was discharged as an arrested case.

*Case 3.*—Male, aged 38 years, was admitted on 4th April, 1940, for bilateral caseo-pneumonic infiltration with much fibrotic changes. Artificial pneumothorax was tried on both sides but failed because of thickened pleura. First stage thoracoplasty operation was performed on the right side on 15th April, first, second and third ribs being resected with good collapse. Then, after a period of nearly five months when the general health of the patient improved, left first stage thoracoplasty was done on 7th September, first, second and third ribs being resected. Later an anterior stage was done on the same side with removal of the anterior stumps of first and the second ribs. The patient was

(Concluded on next page)

## EXTRA-PLEURAL PNEUMOTHORAX POCKETS WITH SINUSES

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The value of extra-pleural pneumothorax in the treatment of certain cases of pulmonary tuberculosis was established by the work of

(Continued from previous page)

discharged in an excellent state of health as an arrested case.

*Case 4.*—Male, aged 32 years, was admitted on 13th August, 1938, for bilateral caseo-pneumonic infiltration with much fibrotic change in the lesions. Artificial pneumothorax was tried on both sides but failed because of pleural symphysis; therefore left first stage thoracoplasty was done on 13th January, 1939, first, second and third ribs being resected. Within one month second stage on the same side was done fifth and sixth ribs being resected. A month later a third anterior stage was done the anterior stumps of first, second and third ribs being resected with a good collapse. The patient was discharged at his own wish after a further period of six months, as much improved (quiescent) case. Patient was readmitted eight months later with signs and symptoms of tuberculosis with positive sputum. The right lung showed active lesions. The right side thoracoplasty was done in two stages, five ribs being resected. The patient was later discharged as an arrested case.

*Case 5.*—Male, aged 45 years, admitted on 30th August, 1938, for bilateral caseo-pneumonic infiltration with much fibrosis. Artificial pneumothorax was tried on both sides but failed. Therefore, first stage thoracoplasty operation was done on the left side small lengths of the first four ribs being resected. Second stage was done nearly a month later, the fifth rib and the anterior stumps of second, third and fourth ribs being resected. After an interval of nearly three months first stage thoracoplasty was performed on the right side, the first five ribs being resected. This was done because there was little collapse after the removal of the first three ribs. The patient was later discharged as an arrested case.

### Discussion

A report is made of ten patients on whom bilateral thoracoplasty operation was performed. Notes on five cases are presented.

The mortality is nil and the results of the operations are very encouraging. The patients were discharged as arrested cases and are to this day keeping good health and doing their regular work. Indications and contra-indications were strictly observed. Local anaesthesia was used. There were no post-operative complications. The operations were performed in several small stages at suitable intervals.

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Graf and Schmidt. A number of papers have appeared explaining the indications and contra-indications of the operation, and several others assessing the results of the operation.

In this operation the stripping of the two layers of pleura from the wall of the chest must be done very carefully. When the pleura is separated from the chest wall an extra-pleural space or pocket is created, which is maintained by occasional re-fills with air as is done in artificial pneumothorax treatment. The procedure keeps the lung collapsed and thus the underlying disease of the lung may be brought under control. If the operation is too extensive, there is the risk of hæmorrhage into the space and consequent infection; and, if the operation takes a long time (as it always does), the resistance of the tissues is lowered and infection often takes place.

It is difficult for the thoracic surgeons to solve the problem of infection that takes place in the extra-pleural space, which is one of the grave complications of this operation. It is extremely difficult to avoid infection because, in all these cases, the general condition of the patient is poor and the operation is extensive and prolonged.

If infection occurs, pus forms in the extra-pleural space, and several sinuses are formed at the site of the opening made in the thoracic wall and also at other places. The extra-pleural pocket resembles an abscess cavity with the difference that, while in an ordinary abscess cavity the walls are elastic, in this space the walls are rigid, consisting of ribs, etc. Therefore this cavity is not obliterated spontaneously as are other abscess cavities, when the pus is drained. Further, the obliteration of the cavity does not take place, since the collapsed lung does not re-expand to fill up the cavity created by the operation. Therefore the treatment consists in collapsing the rigid walls to obliterate infected space. This is achieved by doing a paravertebral extra-pleural thoracoplasty operation.

In this sanatorium extra-pleural pneumothorax was done in sixteen cases; in nine, i.e., 56 per cent of the cases, this pneumothorax was maintained and the patients were discharged as much improved. One patient died of shock after the operation. Two patients were discharged as hopeless cases because of the bilateral infiltration of the lungs and poor general condition. In four cases the extra-pleural pneumothorax pocket became infected. Of these four patients two died without a thoracoplasty operation being performed and the other two patients, on whom thoracoplasty was performed, were later discharged as arrested cases.

These two illustrative cases are given below :—

*Case 1.*—Mrs. R. S. was admitted on 27th July, 1941, with sinus on the right side due to infected extra-pleural pocket, after operation. After nearly a year and a half, the sinus had not closed. Her sputum was negative. First stage thoracoplasty operation was

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PLATE XXIV  
BILATERAL THORACOPLASTY : REPORT ON 10 PATIENTS : G. SAMUEL

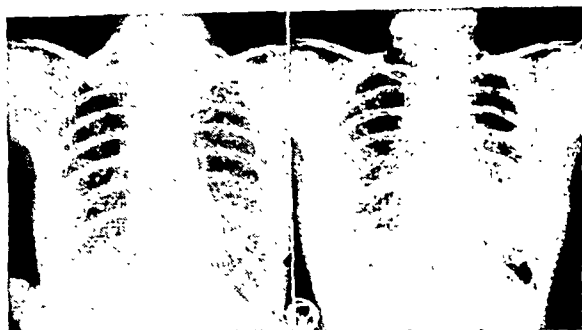


Fig. 1. Case 1.  
Before operation.

Fig. 2. Case 1.  
After operation.



Fig. 3. Case 2.  
Before operation.

Fig. 4. Case 2.  
After operation.



Fig. 5. Case 3.  
Before operation.

Fig. 6. Case 3.  
After operation.

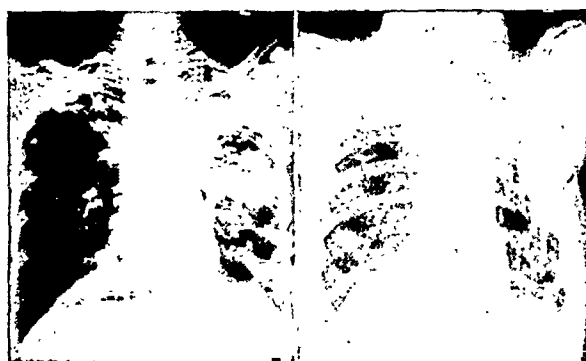


Fig. 7. Case 4.  
Before operation.

Fig. 8. Case 4.  
After operation.



Fig. 9. Case 5.  
Before operation.

Fig. 10. Case 5.  
After operation.



PLATE XXV  
EXTRA-PLEURAL PNEUMOTHORAX POCKETS WITH SINUSES : G. SAMUEL

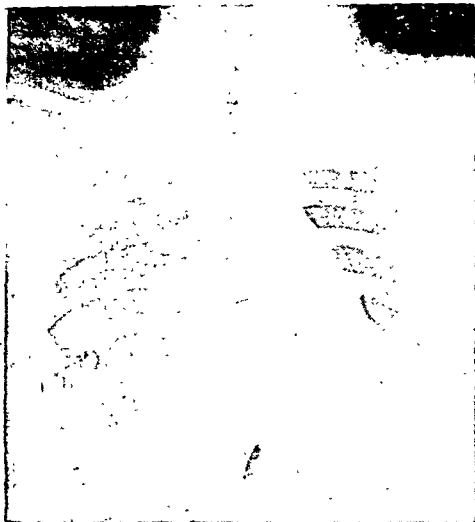


Fig. 1. Case 1.  
Before treatment.



Fig. 2. Case 1.  
After treatment.



Fig. 3. Case 2.  
Before treatment.



Fig. 4. Case 2.  
After treatment.

# BEHAVIOUR OF THE CONTRALATERAL LUNG IN AMBULATORY CASES UNDER UNILATERAL PNEUMOTHORAX TREATMENT

(A RECORD OF 500 CASES)

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THE number of tuberculosis cases found suitable for artificial pneumothorax treatment at the out-patient's section of the chest department, Medical College Hospitals, is always far in excess of the bed capacity of the hospital. Due to this extreme dearth of beds it was decided that, after the first refill, cases would be treated as out-patients. Such ambulant treatment is likely to be risky in various ways. Fresh spread or extension of the disease in the contralateral lung is an important risk among them. As the force of circumstances made us introduce this line of treatment in 1930 and as sufficient data have accumulated by this time, it is important that an assessment of this risk should now be made. This paper has been strictly restricted to the observations on the behaviour of the contralateral lung under this ambulant unilateral pneumothorax treatment.

In unilateral collapse, the other lung is subjected to influences both for and against the formation of new lesions or exacerbation of pre-existing lesions. The factors for it are strain for compensating function, increased chance of aspiration of pressed-out infective material, and sudden and heightened auto-tuberculization (as reported by Alexander, 1937). The factors against it are ultimate diminution of toxæmia, closure of main infective foci or cavities, congestion (Bier's effect) and relaxation, to a slight extent, produced in the contralateral lung, as shown by Ascoli (1929) and Simon (1921).

Rist (1927) in his series of 759 cases recorded 75 per cent of the deaths as due to contralateral

spread. Matson *et al.* (1924), on the other hand, recorded serious extension of contralateral disease in 7.9 per cent in a series of 480 cases. Simon (1921) showed that pneumothorax had no bad effect on the lesions of the contralateral lung of rabbits in which the lesions had been produced by intravenous injection of tubercle bacilli. Burrell and Macnalty (1922) had noted that 'a small lesion in the better lung disappears or becomes much improved when the other lung has been collapsed'. Their question 'what effect do you consider a pneumothorax has upon the other lung?' put to medical superintendents of sanatoria brought out the following information; in 67 cases of Carling, the better lung 'lit up' in 5 cases. Morriston Davis noted improvement in the secondary lesions but no effect on the healthy or primarily infected lung. Felkin, Fernandez, Lillingston, Lucas, Pearson, and Woodcock saw good results, and Riviere, Rolleston, Sutherland, Tattersall, Walker and Wingfield saw good or no ill effect with certain reservations.

Most workers to-day believe that collapse of one lung, if produced gradually, not only entails no great hazard for the other lung, but actually acts beneficially on the lesions in it, or diminishes the chance of formation of new lesions in it. Almost all the investigations done on this subject related to sanatorium patients. Such patients were generally well-controlled, and pneumothorax therapy was conducted non-ambulant for the first few months at least.

The present series of patients were in quite a different category. After the initial artificial pneumothorax, they were hospitalized for only 24 or 48 hours. Thereafter the patients had to travel from home for refills. Our patients are generally of the poor class and, Calcutta being a large city, most of them had to travel 4 to 6 miles in public conveyances. Many came from neighbouring places 20 to 25 miles away from the town. Besides this exertion of the journey, many of them continued to work or began work much too soon, or could have no adequate rest at home, chiefly for financial reasons. It will therefore be realized that the likelihood of contralateral spread or exacerbation was likely to be much more in this series than in the sanatorium group of patients. We believe that the conditions of administering artificial pneumothorax are almost the same everywhere in India. It should, therefore, be worth while recording our findings, in order to try to improve our judgment in the selection and control of such artificial pneumothorax cases in future.

## Method of collection of data and some general information

All the records of artificial pneumothorax cases from 1930 to 1940, whose treatment had been concluded or abandoned, were examined. Cases with incomplete records or in which the duration of artificial pneumothorax was less than 6 weeks were excluded from this series.

(Continued from previous page)

done on 15th August; this closed the extra-pleural pocket, the sinus healed and the patient was discharged in an excellent condition on 4th September, 1941.

Case 2.—Mr. V. C. was admitted on 8th April, 1940, for bilateral caseo-pneumonic infiltration. As his general condition was poor extra-pleural pneumothorax was done on the left side on 31st October under local anaesthesia. The cavity closed and the sputum became negative. The contra-lateral spread improved but the extra-pleural pocket became infected and developed a sinus. The patient was slowly getting worse because of the infection. On 24th January, 1941, the sinus was enlarged and packed with iodoform gauze, with no effect. Therefore thoracoplasty was undertaken in four stages with the result that the pocket closed.

The numbers of completely recorded cases included each year from 1930 to 1940 were as follows:—1, 1, 4, 18, 45, 53, 62, 88, 106, 78, and 44. The records of the earlier period were not so complete as those of later years; this accounts for the small numbers of cases quoted from the earlier years.

The causes of abandonment of artificial pneumothorax at the out-patients' section of the chest department and their numbers in each group were as follows:—patients' inability to continue—277, obliterative pleurisy—83, ineffective collapse—35, hospitalized—19, contralateral spread—32, and termination after optimum conduction—54 = total 500.

It is evident that artificial pneumothorax had to be abandoned prematurely at varying periods

affected contralateral lung, (c) the lesions improved, (d) the lesions remained stationary, and (e) the lesions progressed.

Tables are made to show the above-mentioned groups in relation to (1) some epidemiological factors, (2) the types of lesions and complications, and (3) some special factors connected with the conduct of artificial pneumothorax. A general table, without any special consideration of any factor, comparing the condition of the contralateral lung before and at the termination of artificial pneumothorax, has also been included. Conclusions were drawn whenever the findings on statistical analysis possessed a sufficiently significant value.

(A) *Behaviour of the contralateral lung in relation to some epidemiological factors.*

TABLE I  
*Age and behaviour of contralateral lung*

| State of contralateral lung before artificial pneumothorax | Normal (270) |             | Minimal lesion (160) |             |             | Moderate lesion (56) |             |            | Moderate lesion with cavity (14) |            |            | Total |
|--|--------------|-------------|----------------------|-------------|-------------|----------------------|-------------|------------|----------------------------------|------------|------------|-------|
|  | Normal       | Affected    | Improved             | Stationary  | Progressed  | Improved             | Stationary  | Progressed | Improved                         | Stationary | Progressed |       |
| Behaviour after artificial pneumothorax                    |              |             |                      |             |             |                      |             |            |                                  |            |            |       |
| 5-14 years (child) ..                                      | 2<br>66.7%   | 1<br>33.3%  | 1<br>33.3%           | ..          | 2<br>66.7%  | ..                   | ..          | ..         | ..                               | ..         | 1<br>100%  | 7     |
| 15-24 years (young adult) ..                               | 76<br>69.1%  | 34<br>30.9% | 17<br>31.5%          | 18<br>33.3% | 19<br>35.2% | 4<br>19.0%           | 10<br>47.7% | 7<br>33.3% | 2<br>40.0%                       | 1<br>20.0% | 2<br>40.0% | 190   |
| 25-39 years (adult) ..                                     | 107<br>82.3% | 23<br>17.7% | 40<br>43.8%          | 33<br>36.3% | 18<br>19.9% | 8<br>27.6%           | 12<br>41.4% | 9<br>31.0% | 2<br>33.3%                       | 3<br>50.0% | 1<br>16.7% | 256   |
| 40- (advanced age) ..                                      | 21<br>77.7%  | 6<br>23.3%  | 2<br>16.7%           | 8<br>66.6%  | 2<br>16.7%  | 1<br>16.7%           | 4<br>66.6%  | 1<br>16.7% | ..                               | 1<br>50.0% | 1<br>50.0% | 47    |
| TOTAL ..   | 206          | 64          | 60                   | 59          | 41          | 13                   | 26          | 17         | 4                                | 5          | 5          | 500   |

in many cases due to the inability of patients to come for treatment. These cases had been included in this series to get a true cross-section of results as they occur in an out-door dispensary.

The information about each case was collected in a specially prepared statistical schedule, punched and tabulated at the statistics department of the All-India Institute of Hygiene and Public Health. For dearth of space the general schedule and many other tables could not be incorporated in this paper.

The condition of the contralateral lung previous to the induction of artificial pneumothorax was recorded in four main groups: (1) normal; (2) minimal lesion, when its extent was less than half a lung zone; (3) moderate lesion, when its extent was from half to one zone; and (4) lesion with cavity. In order to assess the effect at the abandonment of artificial pneumothorax, the changes were observed and recorded in the following manner: (a) contralateral lung remained normal, (b) the normal contralateral lung was affected, and in previously

The above table produces comparable data in the 15 to 24 years and 25 to 39 years groups, the other two groups being small. The data clearly show that the danger of contralateral spread or exacerbation is much greater in the 15 to 24 years or young adult group than in the 25 to 39 years or adult group. The previously normal lung of the former group was affected in 30.9 per cent and of the latter only in 17.7 per cent; pre-existing minimal lesions of the former group, 35.2 per cent and of the latter, only 19.9 per cent, progressed; of 'moderate lesion' and in 'lesions with cavity' groups, the corresponding figures are 33.3 per cent and 31 per cent and 40 per cent and 16.7 per cent. It is also noticeable from a comparison of all the groups that with the advancement in age, the chance of contralateral spread becomes less.

It will be seen that the previously normal lung was affected more in males than in females; whereas the pre-existing lesions progressed more in females than in males. This difference in behaviour is interesting, showing more potentiality of a lesion in females but no more

or even less likelihood of developing fresh lesions.

The Hindus and Moslems show comparable data, other groups are rather small. The

figures tend to show that the contralateral lung of the Moslems fared worse than that of the Hindus both in the previously normal and pre-existing lesion groups.

TABLE II  
*Sex and behaviour of contralateral lung*

| State of contralateral lung before artificial pneumothorax | Normal       |             | Minimal lesion |             |             | Moderate lesion |             |             | Moderate lesion with cavity |            |            | Total |
|--|--------------|-------------|----------------|-------------|-------------|-----------------|-------------|-------------|-----------------------------|------------|------------|-------|
| Behaviour after artificial pneumothorax                    | Normal       | Affected    | Improved       | Stationary  | Progressed  | Improved        | Stationary  | Progressed  | Improved                    | Stationary | Progressed |       |
| Male .. ..   | 162<br>75.3% | 53<br>24.7% | 53<br>42.4%    | 46<br>36.8% | 26<br>20.8% | 10<br>20.7%     | 25<br>50.0% | 15<br>30.0% | 4<br>30.7%                  | 5<br>38.6% | 4<br>30.7% | 403   |
| Female .. ..   | 44<br>80.0%  | 11<br>20.0% | 7<br>20.0%     | 13<br>37.2% | 15<br>42.8% | 3<br>50.0%      | 1<br>16.7%  | 2<br>33.3%  | ..                          | ..         | 1<br>100%  | 97    |

TABLE III  
*Community and behaviour of contralateral lung*

| State of contralateral lung before artificial pneumothorax | Normal       |             | Minimal lesion |             |             | Moderate lesion |             |             | Moderate lesion with cavity |            |            | Total |
|--|--------------|-------------|----------------|-------------|-------------|-----------------|-------------|-------------|-----------------------------|------------|------------|-------|
| Behaviour after artificial pneumothorax                    | Normal       | Affected    | Improved       | Stationary  | Progressed  | Improved        | Stationary  | Progressed  | Improved                    | Stationary | Progressed |       |
| Hindu .. ..  | 137<br>78.7% | 37<br>21.3% | 44<br>39.2%    | 40<br>35.7% | 28<br>25.1% | 8<br>21.6%      | 18<br>48.6% | 11<br>29.8% | 2<br>25.0%                  | 3<br>37.5% | 3<br>37.5% | 331   |
| Moslem .. ..   | 48<br>67.6%  | 23<br>32.4% | 12<br>34.2%    | 14<br>40.0% | 9<br>26.8%  | 5<br>33.3%      | 5<br>33.3%  | 5<br>33.4%  | 2<br>40.0%                  | 2<br>40.0% | 1<br>20.0% | 126   |
| Anglo-Indian .. ..   | 10<br>77.0%  | 3<br>23.0%  | 2<br>50.0%     | 1<br>25.0%  | 1<br>25.0%  | ..              | 2<br>100%   | ..          | ..                          | ..         | 1<br>100%  | 20    |
| Others .. ..   | 11<br>91.6%  | 1<br>8.4%   | 2<br>22.2%     | 4<br>44.5%  | 3<br>33.3%  | ..              | 1<br>50.0%  | 1<br>50.0%  | ..                          | ..         | ..         | 23    |

TABLE IV  
*Habitation and behaviour of contralateral lung*

| State of contralateral lung before artificial pneumothorax | Normal       |             | Minimal lesion |             |             | Moderate lesion |             |            | Moderate lesion with cavity |            |            | Total |
|--|--------------|-------------|----------------|-------------|-------------|-----------------|-------------|------------|-----------------------------|------------|------------|-------|
| Behaviour after artificial pneumothorax                    | Normal       | Affected    | Improved       | Stationary  | Progressed  | Improved        | Stationary  | Progressed | Improved                    | Stationary | Progressed |       |
| Urban .. ..  | 148<br>75.8% | 47<br>24.2% | 38<br>35.5%    | 40<br>37.3% | 29<br>27.2% | 9<br>23.7%      | 20<br>52.6% | 9<br>23.7% | 3<br>27.2%                  | 3<br>27.2% | 5<br>45.6% | 351   |
| Semi-rural .. ..   | 32<br>80.0%  | 8<br>20.0%  | 7<br>30.4%     | 10<br>43.4% | 6<br>26.2%  | ..              | 4<br>40.0%  | 6<br>60.0% | ..                          | ..         | ..         | 73    |
| Rural .. ..  | 26<br>74.2%  | 9<br>25.8%  | 15<br>50.0%    | 9<br>30.0%  | 6<br>20.0%  | 4<br>50.0%      | 2<br>25.0%  | 2<br>25.0% | 1<br>33.3%                  | 2<br>66.7% | ..         | 76    |
| TOTAL .. ..  | 206          | 64          | 60             | 59          | 41          | 13              | 26          | 17         | 4                           | 5          | 5          | 500   |

There is no significant finding to suggest that habitation has any effect on the behaviour of the contralateral lung.

(2) *Types of lesions in the lung collapsed*  
The lesions were classified into exudative, intermediate and productive as defined by the

TABLE V  
*History of contact and behaviour of contralateral lung*

| State of contralateral lung before artificial pneumothorax | Normal       |             | Minimal lesion |             |             | Moderate lesion |             |             | Moderate lesion with cavity |            |            | Total |
|--|--------------|-------------|----------------|-------------|-------------|-----------------|-------------|-------------|-----------------------------|------------|------------|-------|
| Behaviour after artificial pneumothorax                    | Normal       | Affected    | Improved       | Stationary  | Progressed  | Improved        | Stationary  | Progressed  | Improved                    | Stationary | Progressed |       |
| History Positive .. ..                                     | 48<br>68.6%  | 22<br>31.4% | 19<br>38.0%    | 14<br>28.0% | 17<br>34.0% | 2<br>20.0%      | 6<br>60.0%  | 2<br>20.0%  | 1<br>33.4%                  | ..         | 2<br>66.6% | 133   |
| History Negative .. ..                                     | 158<br>79.0% | 42<br>21.0% | 41<br>37.2%    | 45<br>40.9% | 24<br>21.9% | 11<br>24.0%     | 20<br>43.5% | 15<br>32.5% | 3<br>27.2%                  | 5<br>45.6% | 3<br>27.2% | 367   |
| TOTAL ..   | 206          | 64          | 60             | 59          | 41          | 13              | 26          | 17          | 4                           | 5          | 5          | 500   |

The figures indicate that the normal contralateral lung was affected and pre-existing contralateral lesions were exacerbated in greater number in those with a history of contact than in those without it.

(B) *Behaviour of the contralateral lung in relation to the types of the lung lesions, complications, etc.*

(1) *Stage of the disease (according to Turban-Gerhardt classification).*

classification committee of the Tuberculosis Association of India.

Exudative and productive were those where the lesions were predominantly so. Intermediate was a mixture of the above two in almost equal proportions. Each of the above types were divided into 'with' and 'without' cavity. As there were only 9 cases in the 'productive' class, they are not shown in the table. All the three types of the pre-existing lesion in the contralateral lung are shown together to avoid too much subdivision of the numbers.

TABLE VI  
*Stage of disease and behaviour of contralateral lung*

| State of contralateral lung before artificial pneumothorax | Normal       |             | Minimal lesion |             |             | Moderate lesion |             |             | Moderate lesion with cavity |            |            | Total |
|--|--------------|-------------|----------------|-------------|-------------|-----------------|-------------|-------------|-----------------------------|------------|------------|-------|
| Behaviour after artificial pneumothorax                    | Normal       | Affected    | Improved       | Stationary  | Progressed  | Improved        | Stationary  | Progressed  | Improved                    | Stationary | Progressed |       |
| Stage I .. ..  | 23<br>92.0%  | 2<br>8.0%   | 1<br>50.0%     | 1<br>50.0%  | ..          | ..              | ..          | ..          | ..                          | ..         | ..         | 27    |
| Stage II .. ..   | 53<br>80.3%  | 13<br>19.7% | 12<br>52.2%    | 9<br>39.1%  | 2<br>8.7%   | ..              | ..          | ..          | ..                          | ..         | ..         | 89    |
| Stage III .. ..  | 130<br>72.6% | 49<br>27.4% | 47<br>34.8%    | 49<br>36.3% | 39<br>28.9% | 13<br>23.2%     | 26<br>46.4% | 17<br>30.4% | 4<br>28.6%                  | 5<br>35.7% | 5<br>35.7% | 384   |
| TOTAL ..   | 206          | 64          | 60             | 59          | 41          | 13              | 26          | 17          | 4                           | 5          | 5          | 500   |

The figures in the table show that a normal contralateral lung before artificial pneumothorax has a much greater chance of remaining unaffected if the treatment is started at an earlier stage of the disease. The general trend in pre-existing lesions also shows that the progress of contralateral lesions is less when the treatment is begun at an earlier stage of the disease.

It will be seen that in both types of cases, with or without lesions in the contralateral lung before artificial pneumothorax, the type of lesion, exudative or intermediate, in the collapsed side exerted no remarkable influence on the fresh spread or exacerbation of the lesions in the contralateral lung. It will however be clearly seen that lesions with cavity, both exudative and

TABLE VII

*Lesions on the artificial and pneumothorax side and behaviour of the contralateral lung*

| State of contralateral lung before artificial pneumothorax |                | NORMAL      |             | PRE-EXISTING LESION |             |             | Total |
|--|----------------|-------------|-------------|---------------------|-------------|-------------|-------|
| Behaviour after artificial pneumothorax                    |                | Normal      | Affected    | Improved            | Stationary  | Progressed  |       |
| Exudative  | With cavity    | 83<br>72.8% | 31<br>27.2% | 31<br>31.3%         | 42<br>42.4% | 26<br>26.3% | 213   |
|  | Without cavity | 77<br>84.7% | 15<br>15.3% | 24<br>38.0%         | 25<br>39.7% | 14<br>22.3% | 155   |
| Intermediate   | With cavity    | 30<br>68.2% | 14<br>31.8% | 14<br>27.0%         | 19<br>36.5% | 19<br>36.5% | 96    |
|  | Without cavity | 11<br>84.6% | 2<br>15.4%  | 8<br>57.1%          | 4<br>28.6%  | 2<br>14.3%  | 27    |
| TOTAL ..   |                | 201         | 62          | 77                  | 90          | 61          | 491   |

intermediate, on the artificial pneumothorax side exerted a harmful influence on the contralateral lung. Cases with such lesions showed more frequent involvement in the previously normal lung, and also more frequent progression of already existing lesions in the contralateral lung.

(3) *Character of lesions in the contralateral lung*

TABLE VIII

*Character and behaviour of the contralateral lung lesions*

| Character    |                | Improved    | Stationary  | Progressed  | Total |
|--------------|----------------|-------------|-------------|-------------|-------|
| Exudative    | With cavity    | 1<br>10.0%  | 5<br>50.0%  | 4<br>40.0%  | 10    |
|              | Without cavity | 60<br>35.3% | 66<br>38.8% | 45<br>24.9% | 171   |
| Intermediate | With cavity    | 3<br>75.0%  | ..          | 1<br>25.0%  | 4     |
|              | Without cavity | 11<br>35.5% | 16<br>29.0% | 12<br>35.5% | 39    |
| Productive   | With cavity    | ..          | ..          | ..          | ..    |
|              | Without cavity | 2<br>33.3%  | 3<br>50.0%  | 1<br>16.7%  | 6     |
| TOTAL ..     |                | 77          | 90          | 63          | 230   |

Out of 230 cases in the 'contralateral lung lesions' group, 171 were of the 'exudative without cavity' type. Other groups are not large enough to serve the purposes of comparison. However, when the two largest groups, 'exudative' and 'intermediate without cavity', are compared they showed progression of lesion in

24.9 per cent and 35.5 per cent respectively. This seems to indicate that the prognosis of the exudative contralateral lung lesion is better than that of the intermediate type. This finding may be due to the greater chances of retrogression of lesions of the exudative type than of the intermediate one.

(4) *Cases with positive and negative sputum (by ordinary smear and concentration tests only).*

Sputum condition was unknown in 6, so they are not included in the table.

The figures definitely show that in the 'sputum positive' group a large number showed affection of the normal contralateral lung and a large number of already existing lesions in the contralateral lung progressed. It can, therefore, be said that the prognosis of the contralateral lung is better in the sputum negative cases than in the sputum positive ones.

In the series, 429 had no complication, 7 had pregnancy, 14 had glandular involvement, 31 had laryngeal and 8 had intestinal tuberculosis, 3 had effusion and 8 had other complications. As each group with one complication is small, they are all shown together in a table in contrast to the 'no complication' group.

Cases without any complication or with it show in almost equal proportions involvement of a previously normal contralateral lung, but in the 'pre-existing contralateral lesion' group the lesions progressed in far greater number in the group with complications (54.3 per cent) than in the group without it (23 per cent). It seems, therefore, that the presence of complications has no remarkable effect on a normal contralateral lung but has a definitely harmful influence on the pre-existing contralateral lesion.

(C) *The behaviour of the contralateral lung in relation to some special factors connected with the conduct of artificial pneumothorax.*



TABLE IX

*Sputum condition and behaviour of contralateral lung*

| State of contralateral lung before artificial pneumothorax | Normal       |             | Minimal lesion |             |             | Moderate lesion |             |             | Moderate lesion with cavity |            |            | Total |
|--|--------------|-------------|----------------|-------------|-------------|-----------------|-------------|-------------|-----------------------------|------------|------------|-------|
| Behaviour after artificial pneumothorax                    | Normal       | Affected    | Improved       | Stationary  | Progressed  | Improved        | Stationary  | Progressed  | Improved                    | Stationary | Progressed |       |
| Positive sputum ..   | 93<br>68.4%  | 43<br>31.6% | 37<br>35.5%    | 35<br>33.6% | 32<br>30.9% | 12<br>24.5%     | 21<br>42.8% | 16<br>32.7% | 3<br>23.0%                  | 5<br>38.5% | 5<br>38.5% | 302   |
| Negative sputum ..   | 108<br>84.3% | 20<br>15.7% | 23<br>41%      | 24<br>42.8% | 9<br>16.2%  | 1<br>14.3%      | 5<br>71.4%  | 1<br>14.3%  | 1<br>100%                   | ..         | ..         | 192   |
| TOTAL ..   | 201          | 63          | 60             | 59          | 41          | 13              | 26          | 17          | 4                           | 5          | 5          | 494   |

TABLE X

*Complication and behaviour of the contralateral lung*

| State of contralateral lung before artificial pneumothorax | NORMAL       |             | PRE-EXISTING LESION |             |             | Total |
|--|--------------|-------------|---------------------|-------------|-------------|-------|
| Behaviour after artificial pneumothorax                    | Normal       | Affected    | Improved            | Stationary  | Progressed  |       |
| No complication ..   | 178<br>76.0% | 56<br>24.0% | 74<br>38.0%         | 77<br>39.0% | 44<br>23.0% | 429   |
| With complication ..                                       | 28<br>77.7%  | 8<br>22.3%  | 3<br>8.6%           | 13<br>37.1% | 19<br>54.3% | 71    |
| TOTAL ..   | 206          | 64          | 77                  | 90          | 63          | 500   |

(1) *Duration of conduct of artificial pneumothorax and the behaviour of the contralateral lung.*

The data tabulated above show that the unaffected contralateral lung becomes affected in gradually higher percentages up to one year

TABLE XI

*Duration of artificial pneumothorax treatment and behaviour of contralateral lung*

| State of contralateral lung before artificial pneumothorax | Normal       |             | Minimal lesion |             |             | Moderate lesion |             |            | Moderate lesion with cavity |            |            | Total |
|--|--------------|-------------|----------------|-------------|-------------|-----------------|-------------|------------|-----------------------------|------------|------------|-------|
| Behaviour after artificial pneumothorax                    | Normal       | Affected    | Improved       | Stationary  | Progressed  | Improved        | Stationary  | Progressed | Improved                    | Stationary | Progressed |       |
| -6 months .. ..  | 111<br>82.8% | 23<br>17.2% | 22<br>26.5%    | 43<br>51.8% | 18<br>21.7% | 4<br>11.7%      | 21<br>61.7% | 9<br>26.6% | 1<br>11.1%                  | 5<br>55.5% | 3<br>33.4% | 260   |
| -1 year .. ..  | 40<br>70.1%  | 17<br>29.9% | 20<br>41.7%    | 12<br>25.0% | 16<br>33.3% | 4<br>33.3%      | 3<br>25.0%  | 5<br>41.7% | 2<br>100%                   | ..         | ..         | 119   |
| -2 years .. ..   | 43<br>69.3%  | 19<br>30.7% | 11<br>52.3%    | 3<br>14.2%  | 7<br>35.5%  | 4<br>44.4%      | 2<br>22.3%  | 3<br>33.3% | 1<br>50.0%                  | ..         | 1<br>50.0% | 94    |
| Above 2 years .. ..  | 12<br>70.6%  | 5<br>29.4%  | 7<br>87.5%     | 1<br>12.5%  | ..          | 1<br>100%       | ..          | ..         | ..                          | ..         | 1<br>100%  | 27    |
| TOTAL ..   | 206          | 64          | 60             | 59          | 41          | 13              | 26          | 17         | 4                           | 5          | 5          | 500   |

after the induction of artificial pneumothorax. Thereafter it does not show this tendency to any marked degree. The findings regarding progression of the pre-existing contralateral lesion are similar. Thus it seems that the maximum hazard for the involvement of or spread of lesion in the contralateral lung exists during the first year of conduction of artificial pneumothorax. Improvement of the contralateral lesion, on the other hand, shows no such time demarcation. The longer the treatment, the greater is the incidence of improvement in contralateral lesions.

per cent, 23.6 per cent and 19.3 per cent). This tendency is also seen in moderate lesions and lesions with cavity in the contralateral lung, though the numbers are small and are not comparable. The improvement in the contralateral lesion is seen in greater numbers in the 'effective collapse' group (51 per cent) than in the 'partial' (37.6 per cent) and 'ineffective' (14.2 per cent) groups.

It, therefore, appears that the danger of contralateral lung involvement or spread of lesion diminishes according to the effectiveness of the collapse; least in effective collapse, more

TABLE XII

*Nature of collapse of the artificial pneumothorax side and behaviour of contralateral lung*

| State of contralateral lung before artificial pneumothorax | Normal       |             | Minimal lesion |             |             | Moderate lesion |             |             | Moderate lesion with cavity |            |            | Total |
|--|--------------|-------------|----------------|-------------|-------------|-----------------|-------------|-------------|-----------------------------|------------|------------|-------|
|  | Normal       | Affected    | Improved       | Stationary  | Progressed  | Improved        | Stationary  | Progressed  | Improved                    | Stationary | Progressed |       |
| Effective collapse ..                                      | 79<br>85.9%  | 13<br>14.1% | 24<br>51.0%    | 14<br>29.7% | 9<br>19.3%  | 12<br>66.6%     | 5<br>28.0%  | 1<br>6.4%   | 1<br>100%                   | ..         | ..         | 158   |
| Partial collapse ..  | 104<br>71.2% | 42<br>28.8% | 32<br>37.6%    | 33<br>38.8% | 20<br>23.6% | ..              | 15<br>60.0% | 10<br>40.0% | 3<br>27.2%                  | 3<br>27.2% | 5<br>45.8% | 267   |
| Ineffective collapse ..                                    | 23<br>71.9%  | 9<br>28.1%  | 4<br>14.2%     | 12<br>42.9% | 12<br>42.9% | 1<br>7.6%       | 6<br>46.2%  | 6<br>46.2%  | ..                          | 2<br>100%  | ..         | 75    |
| TOTAL ..   | 206          | 64          | 60             | 59          | 41          | 13              | 26          | 17          | 4                           | 5          | 5          | 500   |

(2) *Nature of collapse and contralateral lung.*

It is evident that with 'effective collapse', the chances (14.1 per cent) of formation of new lesions in the previously normal contralateral lung are much less than with partial (28.8 per cent) and ineffective (28.1 per cent) collapse. As is seen, the danger of new lesions in cases with partial and ineffective collapse is almost the same.

The chance of progression of pre-existing contralateral minimal lesions diminishes with the increase in effectiveness of the collapse (42.9

with partial collapse and most in ineffective collapse.

(3) *Mobility of the mediastinum and contralateral lung.*

The groups, as shown in the table, are not of comparable size, yet they tend to show that the involvement of a previously normal contralateral lung is little influenced by the mobility of the mediastinum; but that pre-existing contralateral lesions more frequently progress in those with a definitely mobile mediastinum (47.8 per cent) than in those with almost fixed mediastinum (25.2 per cent).

TABLE XIII

*Mobility of the mediastinum and behaviour of the contralateral lung*

| State of contralateral lung before artificial pneumothorax | NORMAL       |             | PRE-EXISTING LESION |             |             | Total |
|--|--------------|-------------|---------------------|-------------|-------------|-------|
|  | Normal       | Affected    | Improved            | Stationary  | Progressed  |       |
| Mediastinum almost fixed ..                                | 190<br>76.0% | 60<br>24.0% | 69<br>33.3%         | 86<br>41.5% | 52<br>25.2% | 457   |
| Mediastinum definitely mobile ..                           | 16<br>80.0%  | 4<br>20.0%  | 8<br>34.8%          | 4<br>17.4%  | 11<br>47.8% | 43    |
| TOTAL ..   | 206          | 64          | 77                  | 90          | 63          | 500   |

*A general consideration of the condition of the contralateral lung before and at the termination of artificial pneumothorax.*

The table below shows that out of 500 cases, the contralateral lung before artificial pneumothorax was apparently normal in 270 and was affected in 230. Among the 'normal' groups, 64

or the extension of pre-existing lesions, in the other lung.

#### Summary

1. An attempt has been made to find out the behaviour of the contralateral lung during ambulant unilateral artificial pneumothorax treatment.

TABLE XIV

| Condition of the contralateral lung before artificial pneumothorax | CONDITION OF THE CONTRALATERAL LUNG AT THE TERMINATION OF ARTIFICIAL PNEUMOTHORAX |             |             |             |             |       |
|--|---|-------------|-------------|-------------|-------------|-------|
|  | Normal  | Affected    | Improved    | Stationary  | Progressed  | Total |
| Normal .. .. .   | 206<br>76.3%  | 64<br>23.7% | ..          | ..          | ..          | 270   |
| Minimal lesion .. ..   | ..  | ..          | 60<br>37.5% | 59<br>36.9% | 41<br>25.6% | 160   |
| Moderate lesion .. ..  | ..  | ..          | 13<br>23.2% | 26<br>46.4% | 17<br>30.4% | 56    |
| Moderate lesion with cavity ..                                     | ..  | ..          | 4<br>28.5%  | 5<br>35.7%  | 5<br>35.7%  | 14    |
| TOTAL ..   | 206<br>76.3%  | 64<br>23.7% | 77<br>33.5% | 90<br>39.1% | 63<br>27.4% | 500   |

(or 23 per cent) cases developed lesions in the contralateral lung during the course of treatment. In those cases in which a contralateral lesion existed before the induction of artificial pneumothorax such lesions improved in 77 or 33.5 per cent, remained stationary in 90 or 39.1 per cent, and progressed in 63 or 27.4 per cent cases. It will, therefore, be seen that during the conduct of artificial pneumothorax treatment, a previously normal contralateral lung was less frequently affected (23.7 per cent) than the lesion in previously affected lung progressed (27.4 per cent). Nevertheless, the difference is slight and the danger not greatly increased. The results appear to justify the use of ambulatory pneumothorax treatment in bilateral cases, if the other lung is not severely affected.

The table also shows that, the more severe a contralateral lesion is, the greater is its chance of progression. Out of 160 cases with minimal contralateral lesion, 41 or 25.6 per cent progressed, 60 or 37.5 per cent retrogressed; in the moderate lesion group of 56 cases, 17 or 30.4 per cent progressed and 13 or 23.2 per cent retrogressed and in the lesions with cavity group of 14 cases, 5 or 35.7 per cent progressed and 4 or 28.5 per cent retrogressed during the period of artificial pneumothorax treatment. These findings suggest, generally, that the progression or retrogression of a lesion in the contralateral lung is mainly dependent on the inherent nature of such a lesion.

In the absence of a control group not treated by pneumothorax no attempt is made to determine whether collapse of one lung either encourages or prevents the formation of fresh lesion,

2. For this purpose, details of 500 cases are given.

3. The effect in unilateral conduct of artificial pneumothorax on the contralateral lung has been shown generally and in relation to (a) some epidemiological factors, (b) the types of the lung lesions and complications, and (c) some special factors connected with the conduct of artificial pneumothorax.

(a) Epidemiological factors :—

The danger of the contralateral spread (development of a lesion in a previously normal lung) or exacerbation of the pre-existing lesion was greater in the young adults (15 to 24 years) than in the adults (25 to 39 years), in Moslems than in Hindus and in those cases with a history of contact than in those without it. The frequency of exacerbation of the pre-existing lesions was greater in females than in males and habitation showed no significant influence.

(b) Types of lung lesions and complications :—

The danger of contralateral spread or exacerbation of the pre-existing lesions was found to be greater in cases with cavity in the artificial pneumothorax side than in those without it and in cases with positive sputum than in those with negative sputum. Exudative lesions in the contralateral lung retrogressed in greater number than with intermediate lesions. In cases with complication the pre-existing lesion progressed in greater number than in those without it.

(c) Some special factors connected with the conduction of artificial pneumothorax :—

(Concluded on opposite page)

## EARLY DIAGNOSIS AND TREATMENT OF INTESTINAL TUBERCULOSIS

By A. C. UKIL

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### Pathology

TUBERCULOUS lesions in the intestines are strictly comparable to such lesions elsewhere in

(Continued from previous page)

The maximum hazard for the contralateral spread or exacerbation of the pre-existing lesions was noticed during the first year of the treatment, whereas with longer treatment the improvement of the contralateral lesions was found to be more frequent.

The danger of contralateral spread or exacerbation of the pre-existing lesions was found to vary inversely with the degree of collapse; the more effective the collapse the lesser was the danger.

A definitely mobile mediastinum was associated with more frequent progression of the pre-existing lesions than was an almost fixed mediastinum. Mobility of the mediastinum had no appreciable effect on a healthy contralateral lung.

4. A general consideration, without taking any special factors into account, showed that the lesions in a previously affected contralateral lung progressed slightly more frequently than a previously normal lung developed lesions. The results justified the use of ambulatory A.P. treatment in suitable bilateral cases. It also showed that the progression or retrogression of the contralateral lesions was mainly dependent on the potentiality or intrinsic nature of such lesions.

### Acknowledgment

We are grateful to Dr. A. C. Ukil, senior visiting physician, Chest Department, Medical College Hospitals, Calcutta. This work would never have been possible without his continued interest, help and guidance.

Our thanks are due to the Vital Statistics Department of the All-India Institute of Hygiene and Public Health for facilities for statistical analysis given to us and to Mr. N. K. Basu, statistical clerk of the Bengal Tuberculosis Association, for his help in sorting out cards and in tabulation.

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- SIMON, S. (1921) .. *Ibid.*, **5**, 620.

the body. There is initial swelling, with hyperæmia, and it is possible that some early lesions may subside at this stage. As a rule, however, the disease advances and the next stage is one of caseation, after the formation of small tuberculous nodules. The superficial epithelium is next shed and the typical tuberculous ulcer results. Progression and retrogression of different lesions take place side by side, as in pulmonary tuberculosis, and the behaviour of the lesions depends on the bacillary insemination, or toxic action, in the area, which bring about varying degrees of hypersensitiveness of the tissues to tuberculo-toxin with consequent necrosis or hyperplasia, as the case may be.

There are three possible routes by which tubercle bacilli reach the bowel: direct contact, the blood stream and the lymphatics. The tubercle bacillus is prone to attack lymphoid structures. There is very little lymphoid tissue in the upper part of the digestive system and the main collection is found exactly in those parts in which tuberculous ulceration is found to be most common and with which swallowed sputum remains longest in contact, owing to its comparatively slow movement. It seems most likely that the bacillus attacks the bowel through the lymphoid tissue of the Peyer's patches and from there it may spread by lymphatics to the regional glands which are commonly involved. Microscopic examination at first shows a diffuse hyperæmia and round-celled infiltration of the whole intestinal wall, and both the nerve plexuses are as a rule affected, thereby disturbing the nervous control of the bowel, which may account for such symptoms as pain and diarrhoea. The lesions occur anywhere in the small intestine or colon, but in most patients the lesions first develop in the ileo-cæcal region and may remain confined to that region for quite a long time.

The data collected from 1,000 consecutive autopsies performed in the Calcutta Medical College Hospitals, and analysed by me in 1930, indicated that 12.8 per cent of the cases had died of tuberculosis, and that in another 4.8 per cent tuberculosis was found to complicate other diseases. Thus, there were 176 cases of tuberculosis in the above series. In 51.1 per cent of the cases tuberculous ulceration of the intestines was secondary to pulmonary tuberculosis but in 5.1 per cent no demonstrable tuberculous lesions were present in the lung or any other organ. The appendix was involved in 3.9 per cent and the peritoneum in 13.0 per cent of the 176 cases.

In children, there is a predilection for the involvement of the lymph nodes and peritoneum. Tuberculous peritonitis may give rise to adhesions, effusions, or caseous collections between adherent coils of intestine. Tuberculous adenitis may be the principal feature in a case in childhood or adolescence. In adults, the stress of the disease falls on the intestines and is seen in two distinct pathological forms—(a) destructive or ulcero-caseous, and (b) productive or hyperplastic.

Tribedi and Gupta (1941) have recently analysed the evidence obtained in 4,000 consecutive autopsies done between 1905-1940 in the same institution, and have supplied us with extremely interesting figures on the localization and types of intestinal tuberculosis found at autopsy. 45.8 per cent of the cases of tuberculosis in their series showed intestinal lesions, 41 per cent secondary pulmonary tuberculosis, and 4.8 per cent were without any demonstrable pulmonary lesions, as compared with 7 per cent in Viswanathan's series of cases at Vizagapatam (Viswanathan, 1940). Although no part of the intestines was exempt from lesions, the most frequently involved part was the ileum (86.7 per cent), the ileo-cæcal region coming next in order (65 per cent), and the jejunum third (34.5 per cent). Lesions were limited to the small intestines in 31.5 per cent and to the large intestine in 12.3 per cent, and were found in both the small and the large intestines in 56.1 per cent of cases. In Europe and America (Brown and Sampson, 1926) the ileo-cæcal region was found to be involved in 86.7 per cent of cases of intestinal tuberculosis, in contrast to 65 per cent in Tribedi's series. Mesenteric lymphadenitis was present in 80.7 per cent of Tribedi's cases; thus in nearly 20 per cent of the cases of intestinal tuberculosis no glandular involvement was present. In 12 per cent of the cases showed some collection of fluid in the peritoneal cavity. The incidence of appendicular involvement in Europe and America (32-41.7 per cent) is higher than in Calcutta (cf. my figures—3.9 per cent quoted previously). Though the appendix was found to be so frequently involved in Europe and America, acute appendicitis was very rarely noticed in these cases.

Regarding the types of lesions in the intestines, Tribedi found that ulcerations were present in 95 per cent, tubercle formation without ulcers in 3 per cent, and that the lesions in the remaining 2 per cent showed the hypertrophic or hyperplastic form. The *ulcerative type* of lesion is caused by an invasion of the submucous lymphoid tissues. These cases showed little fibrous tissue production. This finding was in close correlation with the types of pulmonary lesions found in a majority of phthisis cases in this country. Although intestinal perforations are expected to be common in these cases, they were noticed only in 7 cases (or 1.2 per cent).

In three of the cases with tuberculous ulcers in the small intestines, Tribedi found in some places in the large intestine fringe-like processes projecting from the mucous membrane due to hyperplastic proliferation of mucous glands, with evidence of tuberculous tissue in the submucous region. These *polypoid* changes, as he calls them, might be due to irritation of the tissues by tuberculo-toxin absorbed from lesions in the neighbourhood.

In three of the cases with the *hypertrophic* or *hyperplastic type* of the disease, the lesions were

limited to the ileo-cæcal region, there was no ulceration and no attendant pulmonary lesions were noticed. Owing to the productive changes and hyperplasia in these cases, a thickened mass was present, which was likely to be confused with neoplasm, producing a boggy swelling, some tenderness on palpation, visible peristaltic waves and, in the later phases, even nausea, colicky pains and obstructive vomiting. In the other two cases of the hypertrophic type, productive changes were less marked and ulceration of the granulation tissue was present. These cases are thought to be due to tubercle bacilli of low virulence.

Most of these cases must have been in adults, as there are few beds for children in the Medical College Hospitals.

The question might arise as to how far bovine tubercle bacilli might be concerned in the production of some of the forms of intestinal and abdominal gland tuberculosis in India. It may be of interest to mention that out of nearly 250 strains of tubercle bacilli isolated from tuberculous lesions in many parts of the body at all ages, we have not yet been able to obtain a bovine type of bacillus (Ukil, 1933; Ukil and Guha Thakurta, 1936). All the twelve strains isolated from mesenteric glands of autopsy cases have been found by us to belong to the *human type*.

### Symptoms

Tuberculosis is notorious for the diversity of its symptoms and the symptoms in intestinal tuberculosis are no exception to this rule. There may be little or no abdominal symptoms even in the presence of advanced disease; or there may be symptoms referable to the intestinal tract in cases in which no demonstrable lesions in any part of the bowel are found by barium meal demonstration and at post mortem. Walsh (1909) did not notice any symptoms in 26 out of 76 cases of intestinal tuberculosis. It has been noticed in the present series of cases, that with active exudative forms of pulmonary tuberculosis the abdominal symptoms usually appear eight to twelve months after the onset of the disease, or even earlier, and that in chronic cases, this period may be much longer. We have had cases of phthisis of five years' duration with no evidence of involvement of the gut, either clinical or radiological.

It must be borne in mind that intestinal lesions are not confined to the advanced stages of phthisis. The importance of early diagnosis of tuberculous entero-colitis arises from the fact that, if detected in its early stages, it can be cured by a combination of various methods, including radiation and vitamin therapy.

It should be borne in mind that the symptoms of intestinal tuberculosis, in the early stages, may be as slight and as indefinite as those of early pulmonary tuberculosis.

In the early stages there are usually slight digestive disturbances. Some degree of anorexia, a feeling of fullness and discomfort after meals which may be accompanied by gas formation and heartburn, unexplained loss of weight, a feeling of malaise, or brief attacks of diarrhoea which readily yield to simple remedies, are commonly present. But these symptoms are often so slight and of such short duration that their significance is apt to be overlooked. If in a known case of pulmonary tuberculosis, slight digestive symptoms are present, and particularly if the patient does not continue to improve, or gets worse, the possibility of the existence of intestinal tuberculosis should be considered, and a careful study made to confirm or exclude its presence, even if the lung lesions are improving or stationary.

As the disease progresses, the symptoms usually increase and vary with the location of the ulcers, the extent of irritation of the nerves, the condition of the mucous membrane, and the involvement of the peritoneum. Pain and diarrhoea are two of the commonest symptoms of intestinal tuberculosis.

Pain is by no means always present, but may be an early symptom. It usually commences in the centre of the abdomen, but later radiates towards the right iliac fossa. Occasionally it is referred to the epigastrium and it may have such a definite relation to meals that the presence of a gastric ulcer may be suspected. It is usually most marked in the afternoon, and it may be accentuated by food. The pain is at first transient and then gradually persists for a longer period. It may be cramp-like or stabbing or colicky in nature, and is aggravated by pressure over the ileo-cæcal region; the pain is probably due either to hypermotility and spasm of the intestinal muscles arising from local irritation of the nerve endings of Meissner's plexus, or to stenosis or to localized peritonitis. A throbbing or burning sensation in the abdomen is said to be associated with the involvement of enlarged mesenteric glands. Pain at the time of or after meals is usually due to reflex peristalsis in the ileum or colon.

Diarrhoea, although often regarded as a classical symptom, is by no means invariably present. Instead of diarrhoea there may be marked constipation, due to muscular spasm. Diarrhoea may be transient, with a perfectly normal bowel action in the intervening periods, or there may be alternate constipation and diarrhoea. Ultimately the diarrhoea becomes frequent, and continuous. The diarrhoea is possibly caused either by increased peristaltic movements or by diminished absorption of water, owing to interference with blood and lymph drainage. It is thought that while ulceration in the small intestine may be associated with diarrhoea or constipation, ulceration in the colon produces, as a rule, diarrhoea, and ulceration at the hepatic flexure of the colon is more commonly accompanied by constipation. The

number and situation of the ulcers have no clear relation to the severity of the symptoms, which may, in fact, be very marked when the only visible post-mortem change appears to be a simple catarrh of the mucous membrane. Tenesmus is present only in cases in which the rectum is involved. Although gross hæmorrhage is rare, intermittent passage of small quantities of blood is common. There is often an associated secondary anaemia. The involvement of the appendix seems to increase the severity of symptoms.

A rise in temperature may or may not be a prominent feature. In cases secondary to pulmonary tuberculosis it is commonly seen that when the pulmonary lesions show retrogression and the patient has remained afebrile for some time, with the involvement of the intestine, the temperature begins to rise again and remains raised, and there is often a steady loss in weight. Any patient with chronic pulmonary tuberculosis, therefore, who fails to gain weight or to make satisfactory progress, should be studied for the existence of tuberculous enteritis, no matter how slight the abdominal symptoms are.

Many of the above symptoms may, however, be present without any demonstrable disease in the intestines. They are then believed to be toxic in origin, and to be the result of functional disturbance in the mechanism of the bowel.

Physical examination, apart from the suspicion aroused by the pulmonary condition and the symptoms, may not reveal anything except localized tenderness in the right iliac fossa. Glandular masses are sometimes palpable. Muscular rigidity is present only when the peritoneum is involved, and when the infection is acute; it is also present in cases with perforation and localized peritonitis. Thus it appears that the presence of tuberculous entero-colitis is first suspected by an alert examiner and then confirmed by certain laboratory and radiological investigations, although the latter may not yield conclusive evidence in some cases. In a few cases, a diagnostic laparotomy and biopsy may be needed to settle the diagnosis.

For differential diagnosis, one has to take into consideration mucous colitis, chronic appendicitis, malignant neoplasms of the intestine, amœbic dysentery, sprue, pellagra, ulcerative (non-tuberculous) colitis, diverticulitis, achylia gastrica, hyperthyroidism and spastic colitis.

The following methods of diagnosis will be found to be useful:—

#### (a) Laboratory methods

Fæces.—The fæces in early cases are usually normal in appearance. As the disease progresses, they become at first mushy, then soft and finally liquid with a foetid odour due to the presence of albumin, pus and peptone. The liquid stool may be pale, due to excess of fat and fatty soap, or dark in colour and frothy, and may contain, besides particles of undigested food, mucus,



blood, pus or even small shreds of mucous membrane due to rapid peristalsis and extensive ulceration. A large majority of the cases in our series showed red blood corpuscles and also occult blood in the faeces. The faeces should invariably be examined for pus and red blood cells, intestinal parasites and occult blood. In examining stools for occult blood, precautions should be taken to exclude meat in the diet.

Twenty-five per cent of our phthisis cases, in which symptoms suggestive of intestinal tuberculosis were present, amœbic infection was found and no evidence of intestinal tuberculosis by fluoroscopy and radiography. One interesting feature of these cases was the absence of loss of weight, which is so common in cases of tuberculous enteritis.

In cases of pulmonary tuberculosis with positive sputum, an examination of the faeces for the presence of tubercle bacilli, by ordinary or by one of the concentration methods, gives little assistance in determining the source of the bacilli. It should, however, be done as a routine procedure in all cases.

It has been thought that the presence in the bowel of large quantities of water-soluble serum proteins, derived from tuberculous ulcers, points to the presence of intestinal lesions. Triboulet devised a test for these proteins, which involves the addition of mercuric chloride and acetic acid to faecal extract and he claims to have obtained 99 per cent of results corresponding to the radiological appearance in these cases. We regret we have not been able to corroborate these claims.

**Blood.**—In most cases there is a relative increase of neutrophils and monocytes. The blood should always be periodically examined for total red cell count, hæmoglobin, leucocyte count, sedimentation rate of red blood corpuscles and Houghton's or Fridodt-Møller and Barton's index. Any production of anæmia (as anæmia is generally present in these cases) or rise in sedimentation index should indicate active trouble in some area, and should lead us to investigate the condition of the intestinal tract, if no other detectable cause is found elsewhere. The sedimentation rate of blood usually rises, but this is not a constant feature. A certain amount of anæmia is almost always present.

#### (b) Roentgenological investigation

X-ray examination constitutes the best single means of diagnosis. The methods used are by no means infallible, and much experience is required to interpret the results.

Tuberculous enteritis involves most commonly the last 18 inches of the ileum, the ileo-cæcal valve and the ascending colon. Non-tuberculous intestinal disturbances of slight degree rarely confine themselves to these regions. Localized spasm and hypermotility of the bowel occur in the region of the ulcers. These can be elicited by making the intestinal wall radio-opaque by an opaque meal (barium sulphate, sold under various commercial names such as

cyto-barium, neo-barium meal, x-ray shadow food, etc.) introduced from above by the mouth or in the form of an enema (barium sulphate or thorium oxide).

The preparation of the patient for the barium meal examination consists in giving a light purgative (such as pulv. glycyrrhizæ co.—2 drachms) 48 hours before examination, followed by a high soap and water or saline enema 24 hours later. The diet should be light. On the morning of examination, he may have a light breakfast with as little milk as possible. Two hours after this, the barium meal, suspended in about 16 ounces of water, is given. The stomach and duodenum are first examined on the screen. The patient is again examined after four to five hours and at nine hours by which time the barium should have arrived at the cæcum. If so, the patient is examined under the screen by palpating the ileo-cæcal region, and this examination may reveal both tenderness and what is called the 'spastic filling defect', which is due to the retention of the barium in the cæcum though it is rarely filled. This is shortly followed by hypermotility. This spastic filling defect and tenderness of the ileo-cæcal region are characteristic of the ulcerative type of intestinal tuberculosis. In the presence of the above findings, the dyspeptic disturbances, even though mild, in a patient with definite evidence of tuberculosis in the lungs or elsewhere, should be considered as caused by tuberculous disease of the intestine, unless proved otherwise.

#### Case.—Ileo-cæcal tuberculosis (ulcerative type).

M. R., Hindu, male, 24 years, urban. Was in England for five years and while there he was once in hospital for chest complaints for a short period in 1933. Came with a history of fever (maximum daily oral 102°F.) for six months, moderate loss of weight, no cough or sputum; marked pain and tenderness in right iliac fossa for two months; poor appetite and constipation.

**Physical signs.**—Chest—nothing abnormal detected; skiagraph—no active lesions found; irregular diaphragmatic margin; a few peribronchial healed foci in left upper lobe. Abdomen—tender and palpable mass in ileo-cæcal area. Stool—no amœba, ova or cysts found. Blood—no eosinophilia; sedimentation rate=49.25 minutes mean; von Bonsdorff's count=213, lympho-monocyte ratio=3:1.

X-rays chest (figure 12). Chest skiagraph showing no active tuberculous focus in lungs.

**Results of barium meal investigation.**—1 four hours after barium meal shows at A—hypermotility in last inch of terminal segment of ileum with spasticity above; at B—same condition at cæcum; at C—same condition in cæco-colic area.

2 and 3 taken at intervals of 5 seconds.

4—taken 10 seconds after no. 3, marked distension of the terminal end of ileum due to spasticity is well seen.

5 and 6 taken at intervals of 15 seconds—spasm has now given way, permitting the meal to enter the lowest segment of ileum and cæcum.

7 to 11 taken at intervals of a minute: 7 to 9 the irregularity of the mucosal surface due to ulceration is clearly visible; 10 and 11—the passage of the meal through the ileo-cæcal valve into cæcum is clearly seen.

**Fluoroscopic examination.**—Five hours after barium meal showed presence of meal head in sigmoid (showing general hypermotility of the large gut) with a small quantity still present (due to spastic stasis) in ileum.



Fig. 1.

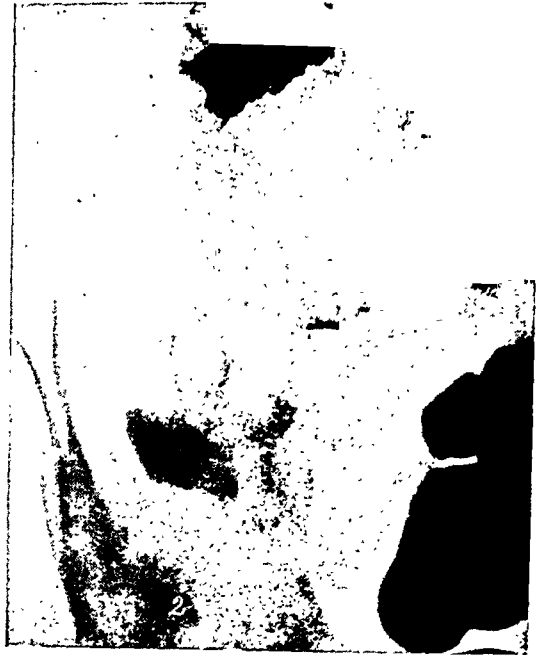


Fig. 2.

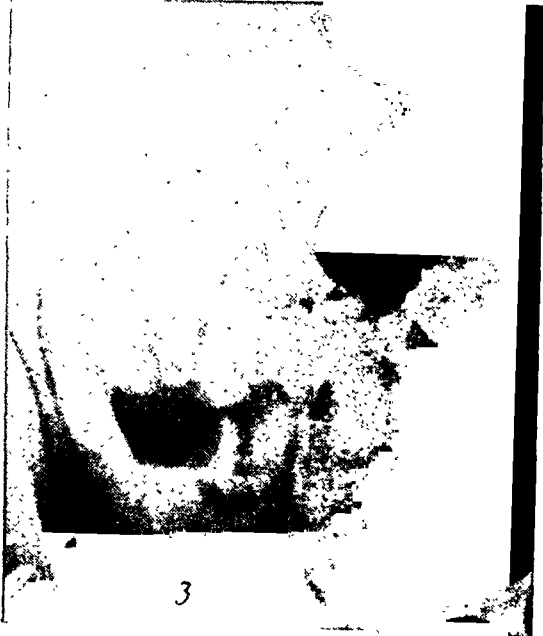


Fig. 3.



Fig. 4.



Fig. 5.

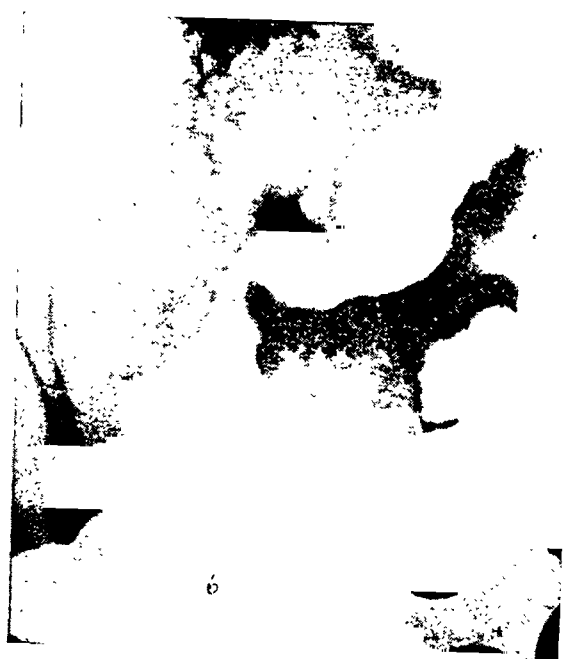


Fig. 6.



Fig. 7



Fig. 8.

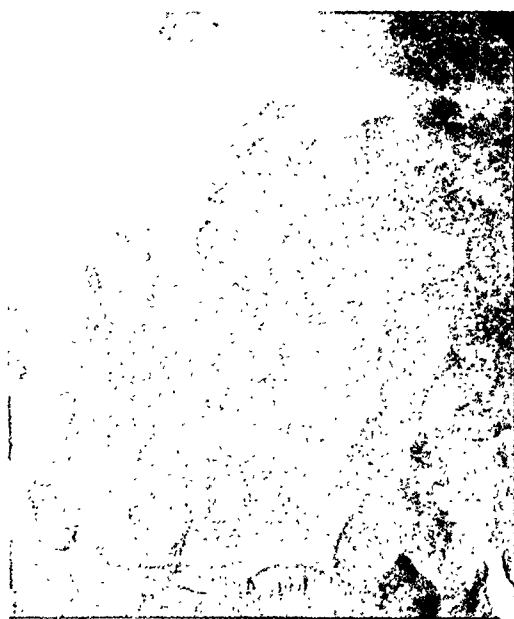


Fig. 9.



Fig. 10.



Fig. 11.

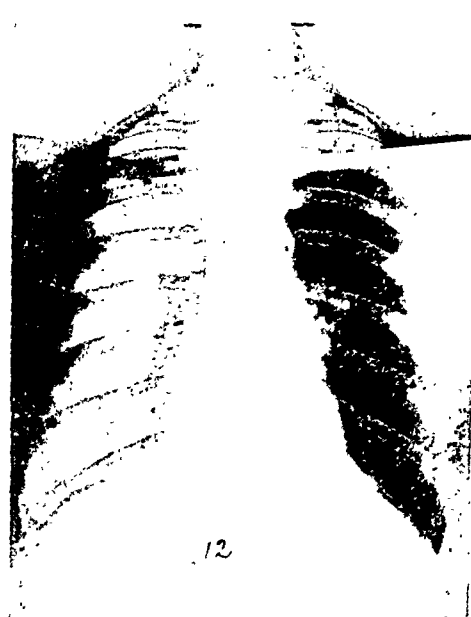


Fig. 12.

The patient made an uneventful recovery under hygiene-dietetic regime and the judicious application of ultra-violet radiation. The improvement has been maintained for two years and he has remained free from symptoms and physical findings of disease.

A barium enema, when introduced 24 hours after the barium meal, gives an outline of the colon and may reveal some phase of the defects in movements. The old barium enema has now been superseded by the barium-air three-stage enema. After the ordinary barium meal examination is made, the patient empties the bowel. A photograph is taken to show the mucosal pattern, if evacuation has been sufficiently complete. The colon is then inflated with a Higginson's syringe under radioscopic control. If too much barium remains, the patient is sent to stool and the process repeated. After final inflation, further photos are taken, preferably stereoscopic.

Recent work has shown (Maingot and others, 1934) that a labile colloidal aqueous suspension of thorium oxide, which has a greater tendency to deposit itself on the mucosa, gives a better outline than barium. The preliminary preparation of the patient is important, however, as the type of flocculation depends on the pH of the contents of the colon.

In considering various diagnostic procedures, it is well to remember that the presence of an associated tuberculous pulmonary lesion is only presumptive, and not conclusive, evidence of an intestinal lesion being tuberculous; and that tuberculous entero-colitis cannot be ruled out in the absence of a tuberculous pulmonary lesion, either clinically or radiologically.

In the rarer-type of the *hyperplastic form* of ileo-cæcal tuberculosis, diagnostic problems vary with the stage of the disease. In the early stages, the symptoms usually simulate those of chronic appendicitis. In the intermediate stages, alternate constipation and diarrhoea, and perhaps a swelling in the right iliac fossa, may be the only features present, giving rise to difficulties of diagnosis from chronic dysentery, regional ileitis (Crohn's disease), carcinoma or unresolved appendical abscess. In the final stages, symptoms of chronic obstruction, becoming acute at times, are evident. Fluoroscopy four to six hours after a barium meal followed by radiography, carefully interpreted, often helps in diagnosis but in many cases biopsy finally solves it.

#### Findings in our cases

We had an opportunity to investigate only 50 cases of pulmonary tuberculosis irrespective of their abdominal symptoms, until the war interrupted our work. The following findings may be found to be of interest:—

|                  |    |    |          |
|------------------|----|----|----------|
| Age.—16-25 years | .. | .. | 30 cases |
| 26-35 years      | .. | .. | 15 "     |
| Above 35 years   | .. | .. | 5 "      |
| Sex.—Male        | .. | .. | 25 "     |
| Female           | .. | .. | 25 "     |

#### Initial pulmonary lesions.—

|  |    |          |
|--|----|----------|
| Exudative type of infiltration                                     | .. | 20 cases |
| Intermediate type of infiltration                                  | .. | 30 "     |
| Unilateral lesions   | .. | 25 "     |
| Bilateral lesions  | .. | 25 "     |
| Under collapse therapy   | .. | 40 "     |
| Lesions in lung showed retrogressive changes in 80 per cent cases. |    |          |

#### Sputum examination (by smear method).—

|   |    |          |
|---|----|----------|
| Initially positive  | .. | 30 cases |
| Positive sputum subsequently became negative on treatment | .. | 20 "     |
| Total period of positive sputum—                          |    |          |
| 3 to 6 months   | .. | 25 "     |
| 6 months to 2 years                                       | .. | 5 "      |
| Throughout negative                                       | .. | 20 "     |

#### Suggestive symptoms and signs.—

|  |             |
|--|-------------|
| Pain and tenderness in cæcal region                        | 30 cases    |
| Vague dyspeptic symptoms such as acidity, flatulence, etc. | 10 "        |
| Diarrhoea  | 15 "        |
| Alternate constipation and diarrhoea                       | 15 "        |
| Constipation   | 5 "         |
| Duration of symptoms—3 months to 2 years.                  |             |
| Slight to moderate anæmia                                  | .. 15 cases |
| Changes in weight—   |             |
| Progressive loss   | .. 20 "     |
| Stationary   | .. 15 "     |
| Gain   | .. 15 "     |

#### Examination of stool

Cysts of *Entamœba histolytica* found—10 cases. Red blood corpuscle and occult blood positive—30 cases.

#### Sedimentation rate of red blood corpuscle

Varied between 25 mm. to 130 mm. at end of one hour.

#### Barium meal investigation.—

|                                   |    |          |
|-----------------------------------|----|----------|
| Apparently normal appearances     | .. | 20 cases |
| Irritability of ileo-cæcal region | .. | 20 "     |
| Spasm without irritability        | .. | 10 "     |

In the ten apparently chronic amœbic cases—some cæcal spasm was present in five cases and no abnormal appearances were noticeable in the remaining five cases.

#### Complications and sequelæ

The frequency of complications depends on the nature and duration of the disease. The following have been noticed in ulcerative intestinal tuberculosis:—

1. Secondary infection.  
Perforation and abscess formation are more likely to occur in these cases.
2. Intestinal hæmorrhage.  
Occult blood is noticed in many early cases but frank hæmorrhage is comparatively uncommon.
3. Stenosis.  
Attempts at healing of the tuberculous ulcers may result in the formation of much connective tissue, which may contract and narrow the lumen of the gut. The condition is much more common in primary intestinal tuberculosis. Strictures occur most frequently in the

ileo-cæcal region, ileum and jejunum, but can occur elsewhere. Intussusception has been reported in a few cases.

4. Localized tuberculous peritonitis, leading to adhesions, localized effusions, localized abscess or formation of fistulæ.
5. Generalized tuberculous peritonitis.
6. Perforation. Perforation may result in general peritonitis or fæcal fistula.
7. Generalized miliary tuberculosis.
8. Amyloid disease.

### Prognosis

The prognosis of intestinal tuberculosis is extremely bad unless the disease is diagnosed in the early stages. As most of the cases are secondary to pulmonary tuberculosis, attempts at prophylaxis should be made by teaching the patients not to swallow their sputum, by giving them a high vitamin diet and a little hydrochloric acid after meals, and by keeping a watch on the earliest symptoms.

If the general condition is good, if the pulmonary condition is in only a moderately advanced stage, if the intestinal lesions are apparently not extensive, and, finally, if the patient can be placed under proper conditions of rest, diet, light therapy and other measures for a sufficient length of time (for it should be remembered that such tuberculous lesions take, on an average, two to three years to heal as in the case of tuberculous lesions elsewhere), the prognosis is not bad. In advanced pulmonary tuberculosis, and with patients in poor condition, the existence of intestinal tuberculosis hastens the inevitable end.

### General principles in treatment

1. *Rest in bed.*—The rest should mean both physical and psychological rest. The patient should be nursed flat and kept as still as possible. A cotton-wool pad over the abdomen is of value in relieving discomfort. Chills must be avoided.

2. *Diet.*—The patient should be given a high caloric, high vitamin, and low-residue diet. A suitable diet in the beginning would be milk diluted with rice water, or gruel, to which 5 per cent glucose and 20 per cent cream are added. Fruit juices, puffed rice, toasted white bread, lightly boiled eggs, jelly, chocolate and weak tea, coffee, or cocoa may be given. If milk does not agree, it should be replaced by whey, *Sprulac* or *Eldon*, or even entirely eliminated. As the clinical condition improves, thick soup, boiled fish, chicken, lean meat, unsalted butter, potatoes, purées, custards and stewed fruits may be added. It is a good plan to give cod-liver oil in full doses in orange, carrot or tomato juice thrice daily. If cod-liver oil does not agree, *viosterol* 20 drops thrice daily may be tried.

3. *Heliotherapy.*—The work of Rollier and Sir Henry Gauvain has demonstrated the value of natural sunlight in cases of non-pulmonary tuberculous disease. This, however, requires

the study of solar radiation (Ghosh *et al.*, 1936; Ukil and Guha Thakurta, 1938) in the area where it is proposed to carry it out, and a considerable experience in its application. Where natural heliotherapy is not possible, ultra-violet light, from either a mercury vapour or a carbon arc lamp, is the best substitute. Ultra-violet radiation has been extensively used in the United States, and in a few centres in India, with encouraging results.

The results depend upon several factors, such as the general condition of the patient, the condition and extent of disease in the intestines, the response to light therapy in general, the reaction of the skin, etc. Favourable results cannot be expected in cases with far advanced pulmonary and intestinal disease, with very little powers of resistance. With heliotherapy or with artificial light, favourable results are obtained in over 60 per cent of suitable cases; most of these showing improvement within three months. Pain, nausea, and vomiting are quickly relieved, but diarrhoea, general digestive disturbances and general systemic disturbances, disappear more slowly. It should be borne in mind, however, that the ultimate results depend not only on the intestinal lesions but also on the condition of the lungs.

In applying ultra-violet radiation, care should be taken that the erythema produced by exposure is slight and that it fades quickly. The exposure, if it is to be beneficial, should give a sense of comfort to the patient. Even when the erythema causes only slight discomfort, the exposures should be stopped for a day or two.

The following scheme of dosage is followed by us, with modifications according to the nature of the case:—

*The first course.*—Place the lamp at a distance of thirty-six inches from the patient. For the first three days, expose the body from the feet to the middle of the calves, for three minutes over the front, and three minutes over the back. On the fourth day, expose for the same period from the feet to the middle of the thigh. On the fifth day, expose for the same period up to the waist. On the sixth day, expose for the same period the whole body, protecting the eyes with goggles, and if the lung lesions are in a markedly hypersensitive state, covering the upper part of the chest from the clavicle to the nipples in front, and a corresponding area at the back.

The lamp-distance remaining the same, the time of exposure is increased by one minute a day over the front and one minute a day over the back, until the back and front are each exposed for 20 minutes. Stick to this for three days and then have a week's rest.

*The second course.*—Lower the lamp by nine inches and proceed in the same way as for the first course. And then again have a week's gap.

*The third course.*—Lower the lamp by another three inches, i.e., place it at a distance of two feet from the patient, and proceed as in the first

course. When this has been tolerated, gradually lower the lamp by a further six inches, and continue as above for a total of three to six months; avoiding peeling of skin or burns and toxic reactions or fatigue. By this time a steady and marked improvement should be noticeable. In cases of intolerance, the interval of exposures might have to be lengthened, the lamp might have to be raised, or fractional doses might have to be applied over fractional areas, until the patient can tolerate the standard dosage. In determining the dosage, the clinical picture, hypersensitiveness of the lesions, the skin-reactions, sense of fatigue and rise of temperature have all to be borne in mind. Periodical blood and x-ray examinations may be undertaken to assess the position.

4. *Roentgen-ray treatment.*—Benefit has also been claimed from x-ray treatment, but this method has so far been comparatively little used. Where ultra-violet ray therapy alone does not give satisfactory results, it might be combined with roentgen therapy. If heliotherapy and x-ray exposures are simultaneously employed, the dosage of x-ray must be cut down. An average dose is 5 milliamperè minutes (90 kilo-volts, 2.5 to 3 milliamperes, filtered through 3 mm. of aluminium, with the tube at a distance of 35 cm.).

5. *Pneumo- or oxygen peritoneum.*—In view of the good results which have been obtained in the treatment of tuberculous ascites by means of pneumo-peritoneum, injections of oxygen have been employed in cases of tuberculous enteritis and some success is claimed for this method. We have not, however, been happy with the results in the few cases in which we have employed this method. The results, of course, depend on the stage of disease in which the method is employed. Most early cases improve without the use of this method, while advanced cases do not seem to obtain a lasting benefit with any method.

6. *Surgical treatment.*—Except for the hyperplastic form of ileo-cæcal tuberculosis, in which pulmonary involvement is often not present, the results of surgical treatment in tuberculous enteritis have not been very encouraging. Not only is the operative mortality high, but also the after-results are often not satisfactory. Results are somewhat better in cases without, or with very slight, pulmonary involvement. Heliotherapy and ultra-violet ray therapy, however, have given much better results.

In cases of localized intestinal disease, where a small part of the bowel is involved, a local excision may be undertaken. Anderson (1940) thinks that in hyperplastic intestinal tuberculosis involving the ileo-cæcal region, the operation of choice is excision with anastomosis of the ileum to the proximal third of the transverse colon. If the patient's condition does not admit of such an extensive operative procedure, a short circuit of the ileum to the transverse colon can be performed, leaving the diseased portion undisturbed.

In cases of acute obstruction, ileostomy is all that can be done.

In ulceró-caseous enteritis, the choice of operation depends on the amount of bowel involved and on the extent and nature of pulmonary disease. In case of stricture or obstructive symptoms due to adhesions, a short-circuit operation gives rest to the affected part, removes obstructive symptoms and may promote healing. Archibald (1920) thinks that there are two chief contra-indications to operation, viz, extensive and progressive pulmonary involvement, and extensive disease of the small bowel; he thinks that it is unwise to attempt operation if more than three feet of the small bowel above the ileo-cæcal sphincter are involved. Resection should not be attempted unless the condition of the lungs is satisfactory.

7. *Medicinal treatment.*—Drugs are only useful in the treatment of symptoms. For loss of appetite, pale tongue and sense of weight after meals, either mineral acids or alkalies, with bitters, before meals may be tried.

For the relief of pain, the following procedures may be adopted:—

(1) Rub the abdomen with an ointment containing 1 drachm each of methyl salicylas and menthol in 4 drachms of lanolin, and cover with flannel, or apply a turpentine stupe after meals.

(2) Heliotherapy or ultra-violet ray therapy often quickly relieves pain.

(3) Calcium chloride, given intravenously as a 10 per cent solution, is of considerable value not only in controlling the diarrhoea, but also in relieving the pain which results from intestinal spasm. K. S. Ray (verbal communication) thinks that irrigation of the colon with 1 in 5,000 solution of acriflavine relieves pain when the lesions are chiefly confined to the ileo-colic region.

To control diarrhoea, first adjust the diet. Then try  $\frac{1}{2}$  to 1 oz. of castor oil once a week, or  $\frac{1}{2}$  to 1 drachm in tomato or orange juice twice daily after meals, followed by astringents like kaolin, bismuth, kino, coto, lead acetate, zinc oxide, etc., and in extreme cases a combination of opium and belladonna with astringents.

Gold, in small doses, may be tried with benefit in early cases.

The results of intensive treatment of tuberculous disease of the bowel, especially in its early stages, are sufficiently good to encourage the hope that better results may be achieved in the future. In the present position of therapy, therefore, every effort should be made to prevent the onset of tuberculous enteritis; if it cannot be prevented, it should be diagnosed in the early stages. In order to achieve this, the physician must be well informed and alert.

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## TYPES OF PULMONARY TUBERCULOSIS FOUND IN DIFFERENT COMMUNITIES, WITH SOME OBSERVATIONS MADE IN NORTHERN INDIA

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Our conception of tuberculosis has undergone great changes since Koch revealed the causal organism and later showed that sensitization of tissue cells plays a significant part in the disease.

We now appreciate the unity of all tuberculous processes. We are able to define the pathological changes which take place at the site of first infection as the simple reaction of the tissues to the presence of the tubercle bacillus and its products, similar to the reaction of tissues to any foreign substance. We now consider the different types of reactions of the tissues of previously infected individuals, on again coming in contact with bacilli, as being evidence of a specific defensive mechanism.

The reaction to tuberculous reinfection is different in different individuals. If it were possible for us to know the particular factors which determine these diverse manifestations, we would thereby greatly increase our understanding of the disease, and improve our chances of finding a satisfactory cure for it.

The real understanding of tuberculosis and its diverse manifestations, and the ability to predict the course a given infection will take, seem to depend upon facts of immunologic nature which, if they were known to us, would explain many of the mysteries which at present surround the disease. However, intrinsic variations in susceptibility and resistance are exceedingly difficult to understand and evaluate, for they are

obscured by inconstant and complicated hereditary and environmental differences.

The reactions of the tissues to the tubercle bacilli produce a combination of cell proliferation and exudation, with or without tissue destruction. While these reactions are not distinctive but are found in one and the same lesion, yet the fact that one or the other almost always predominates goes to show that a different combination of forces is responsible for the different reactions. Anything that will enable us to explain these differences will help us to a better understanding of the specific protective mechanism which the body brings into play in combating tuberculous infection.

We have already made some headway, and in our present partial understanding of this disease we have, in the classification of the disease, discarded the purely descriptive pathology of the past for an interpretative outlook, based on certain recently-acquired knowledge in the field of immunology. The 'primary phase' and the 're-infection phase' of tuberculosis are now generally recognized, although the present views on the pathological character and seriousness of first infection are still divergent (Israel and Long, 1941).

The most common familiar form of pulmonary tuberculosis is the chronic, cavity-forming type. One fact about this chronic form which seems thoroughly established is that it is not a primary manifestation of tuberculous infection, but a late one, preceded by a first infection, often contracted years before.

Chronic tuberculosis may be mainly proliferative or mainly exudative. The former is mild in degree and usually not inconsistent with long life, while the latter is more acute, and there is more danger of the disease spreading quickly and also more danger of tissue destruction.

The two types of manifestations of the disease are, thus, widely different. It is, therefore, important to learn the factors that are responsible for chronicity of the disease in one case and for a fulminant course in another. For proper evaluation of factors responsible for these peculiarities, a basic analysis of the types of disease existing in different communities is necessary.

Furthermore, there are other advantages in undertaking such a study. Chronicity swells the morbidity lists, both through the accumulation of long-lived patients, ultimately dying of other diseases, and the continued widespread dissemination of tubercle bacilli. Investigations such as those conducted in Framingham and Cattaraugus Counties in the United States of America set useful standards for morbidity and necessary hospital accommodation in communities of white people among whom the chronic form of the disease predominates, but these figures probably do not hold for communities where the disease is more acute and of shorter

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duration, as may be the case with the inhabitants of this country (Shah, 1940).

In this connection the figures of Opie and McPhedran (1926) are significant. Opie compared the duration of illness from tuberculosis in the white patients attending the dispensary of the Henry Phipps Institute in Philadelphia with the duration in negroes attending a similar clinic in Kingston, Jamaica, and found that the length of the disease in the whites was approximately three times that in the negroes. In a later paper, McPhedran and Opie have called attention to the rapid character of the disease in many negro families, the whole course from onset to fatal termination sometimes lasting only four months, and several members of the family dying of the disease within one year. In negroes of Jamaica, the ratio of existing cases of clinically manifest tuberculosis to deaths was 2.9. It was 4.3 for negroes and 12.2 for white persons of Philadelphia (Opie *et al.*, 1941).

It is important, therefore, that we gather data on the type of disease prevalent as well as on the spread of tuberculosis in different parts of this sub-continent, and establish standards for hospital accommodation and other control measures on the ratio of infection, morbidity and mortality.

Numerous statistical studies of the types of disease have been undertaken in Europe and in America. Observations made in the United States of America, where the white and the coloured races exist side by side, are of special interest.

Generally speaking, the white race shows a greater resistance to tuberculosis than the negro race. A larger proportion of whites shows a tendency to chronic disease with localization of lesions and marked fibrosis. The tuberculosis of the negro is generally more acute, with more tendency to caseous pneumonia and to generalization by both blood- and lymph-streams.

In this paper an attempt has been made to analyse and discuss the type of disease found in the patients who were treated in the out-patient and in-patient departments of the R. B. Amarnath Tuberculosis Institute, Mayo Hospital, Lahore, from 1st January, 1940 to 30th June, 1942. Altogether, 2,019 patients were skia-graphed. In this study are considered 973 cases skia-graphed and diagnosed as tuberculous.

In the determination of type, reliance has to be placed on *x-ray* observations. Unfortunately necropsy findings are not available. The same criteria have been observed as were laid down by Benjamin (1937, 1938), *viz*: the amount of fibrosis, evidence of previously healed lesions, tendency to dissemination, involvement of one or both lungs, the amount of cavitation, all as shown in *x-ray* films. Unfortunately the evidence of resistance to the disease as shown by the length of time between onset of symptoms and the time of observations, and the activity of the disease as shown by blood examination

(sedimentation test and Schilling count), could not be considered, as the records in these respects are incomplete.

The results of the study are tabulated below:—

TABLE

*Analysis in percentage of findings in 973 cases together with findings in Benjamin's 2,021 cases.*

|                                      | PRESENT SERIES |            | BENJAMIN'S SERIES |            |
|--------------------------------------|----------------|------------|-------------------|------------|
|                                      | Number 973     | Percentage | Number 2,021      | Percentage |
| Exudative .. ..                      | 633            | 65.0       | 1,879             | 93.0       |
| Fibrotic .. ..                       | 216            | 22.2       | 108               | 5.3        |
| Miliary .. ..                        | 18             | 1.9        | ..                | ..         |
| Pleurisy .. ..                       | 106            | 10.9       | 34                | 1.7        |
| Previously healed lesions            | 212            | 21.8       | 321               | 15.9       |
| Localized .. ..                      | 211            | 21.7       | 397               | 19.6       |
| Moderately disseminated              | 371            | 38.1       | 783               | 38.7       |
| Markedly disseminated                | 391            | 40.1       | 841               | 41.6       |
| Unilateral .. ..                     | 305            | 31.3       | 581               | 28.7       |
| Bilateral .. ..                      | 668            | 68.6       | 1,440             | 71.3       |
| With cavities .. ..                  | 390            | 40.1       | 1,482             | 73.3       |
| Cavities with soft walls             | 310            | 79.4       | 1,395             | 94.1       |
| Cavities with moderately hard walls. | 80             | 20.6       | 87                | 5.9        |
| With single cavity ..                | 215            | 55.1       | 704               | 47.5       |
| With two or three cavities           | 107            | 27.4       | 385               | 26.0       |
| With multiple cavities               | 68             | 17.5       | 393               | 26.5       |

From the above table it will be seen that among 973 patients, 633, or 65 per cent, showed predominantly exudative lesions, while 216, or 22.2 per cent, showed predominantly proliferative lesions. Miliary spread in the lungs was demonstrable in 18, or 1.9 per cent; 106, or 10.9 per cent, showed involvement of the pleura only.

Previously healed lesions were found in 212, or 21.8 per cent. Only 211, or 21.7 per cent, showed any tendency to localization, while 391, or 40.1 per cent, showed marked dissemination.

Unilateral disease was found in 305, or 31.3 per cent, while in 668, or 68.6 per cent, both the lungs were involved.

40.1 per cent of the patients showed cavitation, 55.1 per cent of these showing a single cavity and 44.9 per cent showing more than one cavity. Of patients with cavities, 80 or 20.6 had moderately hard-walled cavities, while 310 or 79.4 per cent had soft-walled cavities.

Benjamin, in his study of 2,021 cases, found much more acute types of disease than the present study has revealed. He found evidence of marked fibrosis in only 5.3 per cent, while 93.0 per cent of his cases showed a predominantly exudative type of lesion. In his series, 73.3 per cent showed cavities, half of this number showing multiple cavities. *X-ray* showed only 5.9 per cent of patients to have moderately hard-walled cavities.

Sanjivi (1939) reported the results of a study made by him at the Government Tuberculosis

Hospital, Madras. Unfortunately his tabulation of results is on a basis different from that of Benjamin; therefore, in many respects, the results are not comparable.

Sanjivi found cavities present in 42.9 per cent, the walls of the cavities were hard and fibrous in 20 per cent of these. Mid-zone lesions were found by him in 26.6 to 28.7 per cent, while Benjamin found them in 71.2 to 73.1 per cent. In the present series, mid-zone lesions were found in 40.5 to 42.8 per cent.

Benjamin's results led him to the conclusion that in 'Indian patients the disease is of a very serious type; it is acute, rapidly developing, with little tendency to show a natural resistance and healing'. That the disease prevailing among our people is predominantly acute in type seems to be well established. The present study confirms it. But the very serious view that Benjamin has taken does not seem to be justified in the population of India generally.

The reasons for the extraordinary acuteness of Benjamin's series of cases are not far to seek. His results are based on a study of in-patients of the Union Mission Tuberculosis Sanatorium, Arogyavaram. Only selected cases are referred to the sanatorium by doctors from different parts of the country. A very large majority of patients in our country prefer to get an occasional treatment, either from private practitioners who are usually untrained in the modern methods of diagnosis and treatment of pulmonary tuberculosis, or from the out-patient department of a hospital or clinic. The practitioners usually advise their patients to join an institution only when they find that the disease is advanced or advancing. For this reason, an institution that, for selection of cases, depends upon references from private practitioners and not upon an 'out-door' closely linked with it is likely to get a high percentage of advanced cases.

The present study is based mainly on the out-patient attendance of the tuberculosis institute where not only are the patients given advice and treatment but those who are suitable are admitted to the wards of the institute, while at the same time efforts are made to bring in their 'contacts' in order to discover early cases. In this study, as many as 27.2 per cent were in stage I of the disease. Nevertheless, this also is a selected group, although less selected than Benjamin's. A true picture can only be obtained by conducting extensive surveys among unselected groups.

#### Discussion

At one time the acute course and high mortality of tuberculosis among certain communities was explained on the ground that the disease in such communities was essentially first-infection tuberculosis of rapidly progressive type occurring in adult life, the cause being the general failure of these communities to receive in childhood the mild immunizing infection. This

concept seems inapplicable to the people of this country.

The few tuberculin surveys that have been carried out show that our people are fairly heavily infected during their childhood years. Furthermore, the fact that no less than 21.8 per cent have demonstrable calcified nodes and nodules in the chest, shows that Indians display good resistance to childhood primary infection.

The factors responsible for high mortality and acute course of the disease must, therefore, be sought elsewhere.

Among our people economic conditions and hygienic standards are low. Ignorance and over-crowding lead to intense exposure to infection. On the basis of exogenous adult-type infection, the widespread infection and high mortality are easily understood. Nevertheless the chronicity of the disease seen in 22.2 per cent is notable.

In this connection the experiments of Lurie (1941) on families of rabbits with different genetic constitution are illuminating. He studied the type of disease developed by several rabbit families of different genetic constitution when exposed to tuberculosis in a manner simulating closely that obtaining in human life. The localized, ulcerative, pulmonary disease characteristic of white adults was acquired by the most resistant families of rabbits. Primary, rapidly progressive, generalized tuberculosis, as found in the Senegalese troops in the Great War, was characteristic of the most susceptible families of rabbits. The mixed type of tuberculosis intermediate between these extremes, as found in the American negroes, was typical of the tuberculosis developed by the families of intermediate resistance. Lurie concludes that 'it is likely, therefore, that the varying susceptibility to tuberculosis of the different human groups depends to a large extent on varying genetic rather than environmental factors'.

In more recent years have been published two important reports on the tuberculosis of African negroes that should help us to an understanding of our own problem. One is by Borrel (1920) who observed tuberculosis among the Senegalese troops during the last World War. A large number of them arrived in France, meeting what was for most of them their first contact with tuberculosis. On arrival, only 4 or 5 per cent reacted positively to tuberculin. A fulminant epidemic of tuberculosis developed among them. The disease was characterized by caseation, tracheo-bronchial lymph nodes, caseous pneumonia, extensive serositis and miliary tuberculosis. Mortality was high and rapid. This was typical tuberculosis of 'virgin soil'. It is not the type from which the people of India are suffering to-day.

The other of the two reports to which I have made reference, is that of the Tuberculosis Research Committee of the South African

Institute of Medical Research (1932). It is an exhaustive inquiry into the reasons for high tuberculosis mortality of the negroes employed in the mines in the Rand. In this case the native labourers were already heavily tuberculized on arrival, 70 per cent or more reacting positively to tuberculin. Furthermore, fully 50 per cent of 'healthy natives react to 1:1,000,000 dilution of tuberculin. These natives are, therefore, not 'virgin soil' for tuberculosis. Yet, if they remain in their kraals, the disease is found quiescent. It is only when they are exposed to the heavy labour of the Rand, coupled with under-nourishment and frequent super-infection due to living conditions, that there is activation of the disease. Their tuberculosis, while frequently fulminant in character, was not as massive as that of the Senegalese troops.

This is more nearly comparable to the situation in India to-day. Unfortunately, the tuberculosis mortality and morbidity figures in this country are very incomplete. But a few figures are on record which indicate that, in urban areas at least, it must be four to six times as high as the tuberculosis death rate among Western communities.

The high death rate in Indians cannot be explained by massive infection of 'virgin soil'. The writings of early Hindu physicians indicate that Indians have been tuberculized for many centuries. Racial stocks of this country have passed through long periods of survival of the most fit, and yet the disease is more fulminant than in the whites.

It may well be assumed, therefore, that environmental factors are involved. In general, the Western people have the advantage over Indians in economic status, hygienic standards, housing and dietary habits.

Whether the differences are due largely to true genotypic inherited variations in native susceptibility and capacity for immunization, or are chiefly the result of environmental variations, need much further investigation.

I am grateful to Dr Shabbar Hussain, M.B., B.S., my house physician, for kind assistance in tabulation of statistical data.

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## AN INVESTIGATION INTO THE TYPES OF TUBERCLE BACILLI CAUSING EXTRA-PULMONARY TUBERCULOUS LESIONS IN THE PUNJAB\*

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EVER since the discovery of the tubercle bacillus attempts have been made to determine the types of tubercle bacillus which produce lesions in man and other animals. Bovine strains of the bacillus have been isolated by Fraser (1912), Griffith, Munro (1930), Cumming, Blacklock, Wang and other workers in Great Britain in 27 to 70 per cent of human cases of osteo-articular and glandular tuberculosis, particularly in children. It has been encountered in 19 to 40 per cent of cases of cerebro-spinal meningitis examined by Blacklock, Griffith, Macgregor *et al.* (1934), Jensen (1932) and other workers. The incidence of the bovine type of bacillus isolated from extra-pulmonary lesions in the U.S.A. seems to be less (7.7 per cent according to Gosling and Mantoux) than in the north-European countries. Recent work by Lange (1932), Munro (1930), (Cumming, Foster, Girdwood, and Griffith, 1933), Smith, Jensen (1932) and other workers indicates that a varying percentage (3 to 8 per cent) of pulmonary tuberculosis cases in these countries is caused by the bovine type of tubercle bacillus. Investigations have shown that a high incidence of infection and disease in cattle is related to a higher incidence of the bovine infection in man, particularly among children, and dairymen who attend to cattle.

In India the earliest work available in this connection was that of Soparkar who isolated bovine strains from two cases of glandular tuberculosis and an avian strain from another. Whilst investigating the source of tuberculosis in the animals in the zoological gardens of Bombay, he demonstrated the presence of bovine strains in some of these animals. Soparkar also reported the presence of tuberculosis in 14 per cent of cattle at Ferozepur and Lahore. Taylor, however, showed that tuberculosis in cattle in India is much less than in the West.

More recently Ukil (1933) investigated the problem in Calcutta. He could not report a single case of bovine infection from cases of non-pulmonary tuberculosis.

We conducted this enquiry on lines similar to those of Ukil. We have so far been able to

\* This article has been condensed by Dr. Ukil, at the Editor's request.

cultivate tubercle bacilli from 39 cases, out of which 37 have been completely investigated.

Material was collected from some of the hospitals in Amritsar and Lahore, as well as from private surgeries.

The sources of the material investigated were as follows: cervical glands 21, inguinal glands 1, pus from cold abscesses 10, and peritoneal fluid 7.

After experimenting with several media, Petroff's medium was chosen for routine use in making primary cultures from materials, some of which were sent from out-stations, preserved in 5 per cent glycerine saline with or without the addition of malachite green in the same strength as is present in Lowenstein's medium.

The following technique was adopted by us in culturing tubercle bacilli from pathological materials, with all possible aseptic precautions:—

The material, except in the case of pus when freshly obtained, was triturated with 6 per cent sulphuric acid in a mortar containing a small quantity of sterile sand, poured into a wide-mouthed tube and kept in the incubator at 37°C. for an hour. The acid is then neutralized with normal NaOH and about 0.5 c.cm. of the neutralized material put on to each of a few slopes of Petroff's medium. The tubes were then incubated and inspected every 4 or 5 days up to a period of two months, at the end of which the negative growth tubes were rejected. In case of positive cultures, the strains were subcultured on glycerinated and non-glycerinated media. The character of the growth on the tubes was noted. In addition to direct culture, 1 c.cm. of the neutralized emulsion of pathological material was inoculated subcutaneously into two guinea-pigs, with a view to obtaining primary cultures from any lesions produced in the guinea-pigs. In the case of pus uncontaminated with secondary organisms, a direct culture was made. In contaminated samples, the sulphuric acid method of treatment was adopted.

From the cultures obtained, a homogeneous emulsion of a weighed quantity of tubercle bacilli was made, and 0.01 mgm. of the dry weight of the bacilli was introduced intravenously into rabbits. In some cases, a subcutaneous dose of 10 mgm. was preferred. The animals were killed and autopsied at the end of 8 weeks, if they did not die earlier.

#### Findings

**Cultural characters.**—All the strains isolated are *eugonic* in growth and glycerophilic except two. One of these on subculturing is now giving fairly abundant growth on glycerinated medium also. The growth was generally dry, irregular, tough and tenacious. It was ivory coloured to start with and later on a little bit more yellowishness. All eight strains that have given a definite human type of reaction gave a growth which was slightly moist and glistening, but the growth was adherent in all these cases and

showed on the surface of the usual dry type of growth.

#### Animal inoculation tests

In all we have so far inoculated 107 rabbits for differentiation of the type in 39 strains of tubercle bacilli. We have been using two animals for each of the strains. Actually 78 should have been required but because of intercurrent infections, we had to repeat the inoculation test in some cases. When an animal died earlier than six weeks, the experiment was repeated.

None of the animals lost much in weight. Thirty-seven showed no change and in 10 it was actually increased. All the animals inoculated with 10 mgm. subcutaneously had to be killed. None of them died between 6 to 8 weeks after inoculation, and the autopsy always showed the disease limited to a localized abscess which contained acid-fast bacilli. Of the 90 animals inoculated intravenously 35 showed no tubercle lesions in 6 to 8 weeks after inoculation. The animals that showed disease were always ill from progressive lesions.

It is very important to know the incidence of the bovine infections amongst our people, since the institution of preventive measures depends to a very large extent on our knowledge of the type of bacillus causing infection in this country. Soparkar's findings were to the effect that infection is present in our cattle and the percentage of the infected cattle is likely to increase with overcrowding and bad housing conditions of the animals in the cities.

Tuberculosis in the animals is very uncommon in this country. In the beginning of this enquiry we examined specimens of milk from 25 milk sellers in the city. We used the technique of Cowan and Maddocks to demonstrate the presence of acid-fast bacilli in milk. None of the specimens showed acid-fast bacilli. This matter needs further investigation. It is said that tubercle bacilli in milk be ignored in this country because milk is boiled before use by the people. One who knows the dirty and careless habits of the milk sellers and the habits of the country people who take fresh and unboiled milk of buffaloes, will certainly not feel like dismissing the problem so lightly. We cannot say that the problem of the type of the bacillus has been thoroughly investigated as long as we have not investigated the diseased tissues from a large number of country and urban people. If it is not a problem for the public health worker, it is certainly one for the veterinarian to stamp out the disease amongst the cattle so long as Soparkar's work remains unchallenged.

#### Summary

1. Thirty-nine strains of tubercle bacillus isolated from non-pulmonary sources.
2. Thirty-seven strains have given typical human type of reaction on inoculation into rabbits.

(Concluded on opposite page)

## SOME OBSERVATIONS ARISING FROM TUBERCULOSIS WORK IN THE TUBERCULOSIS CLINIC, NAGPUR

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THE gravity of the menace of tuberculosis in the Central Provinces is probably similar to that of the other provinces in India and we are forced to recognize its seriousness. I will first describe briefly what is being done in the province with regard to tuberculosis.

### *Anti-tuberculosis activities in the Central Provinces*

The Government of the Central Provinces and Berar has put forth a well-planned anti-tuberculosis campaign. The scheme, which was approved by Dr. C. Frimodt-Möller, was launched in 1937 under the leadership of Major-General N. M. Wilson, the then inspector-general of civil hospitals of the province. The scheme though a modest one is so planned as to be able to develop in the right way in an ever-increasing measure in the future.

Four tuberculosis clinics, which are more or less fully equipped, were opened in four important centres in the province, namely Nagpur, Jubbulpore, Amraoti and Raipur. The Pendra Road Sanatorium in Bilaspur district, about 300 miles from Nagpur, was organized on an up-to-date basis and is under the management of the united board of eleven missions. The four clinics, which belong to the provincial medical department, and the sanatorium are in the charge of experienced and well-qualified men and work in co-operation. Forty beds in the sanatorium are reserved by the Government for indigent patients and the sanatorium receives a yearly grant for the same from the Government. The

*(Continued from previous page)*

3. Two other strains which appear to be human from cultures are still to be differentiated.

We are highly grateful to the Amritsar municipality for granting us annually Rs. 2,000 for a period of two years as it would not have been possible to institute the enquiry without this aid. Our thanks are no less due to Lieut.-Colonels P. B. Bharucha, V. R. Mirajkar and P. A. Dargon and other medical officers who supplied the necessary morbid materials.

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\* Of the references mentioned in the text the authors have given only seven in the list.—Editor, I. M. G.

sanatorium is now recognized to be one of the best in India.

From 1926 to 1937 an Anti-Tuberculosis League was in existence in Nagpur under the private auspices of the late Dr. Roy. This league had collected Rs. 27,000. This fund, and a contribution of Rs. 40,000 by the provincial Red Cross from the Silver Jubilee Fund, equipped the four clinics.

The Anti-Tuberculosis League was merged in 1937 with the Anti-Tuberculosis Association of the Central Provinces and Berar, which is affiliated to the Tuberculosis Association of India. This Anti-Tuberculosis Association, on Her Excellency the Marchioness of Linlithgow's all-India appeal, has so far collected about Rs. 98,000.

The Tuberculosis Association of the Central Provinces and Berar is providing post-graduate training for selected doctors at the Pendra Road Sanatorium. Arrangements are also being made to train tuberculosis health visitors in the province. When funds permit it is proposed to open more clinics in other important centres. Among various other measures of improvement of the existing clinics, is the plan to construct detention wards and to establish tuberculosis settlements and camps. The war has called a halt to many of our nation-building works and is affecting in no small measure our anti-tuberculosis schemes.

### *Tuberculosis problem in Nagpur city*

Nagpur city covers an area of about 6,000 acres and has a population of over three lakhs; there are about 50,000 houses with an average of over six persons in each. The total deaths per year are about 9,000, that is about 30 per 1,000 of the population. It is estimated that about one in every ten deaths in India is due to tuberculosis, and that for every one who dies from tuberculosis, there are ten who are suffering from the disease. This would mean that there are about 900 deaths from tuberculosis in Nagpur city every year, and about 9,000 cases of active tuberculosis, most of them undetected and at large, spreading the infection.

### *Tuberculosis Clinic, Nagpur*

The Nagpur Tuberculosis Clinic was established as a self-contained unit in May 1938, though the actual work of the clinic was started in July 1937 in the local general hospital. The cost of the building and its equipment amounted to Rs. 30,000. The clinic is equipped with a dispensary, laboratory, x-ray plant for radiography and screening, ultra-violet outfit, dark room, operation theatre, waiting rooms, consultation room, examination room, two detention wards, each with two beds; it is situated in the heart of the city and is easily accessible. It is in the charge of an assistant surgeon of the provincial medical service, specially qualified for the post. The rest of the staff consists of two qualified compounders (one of whom is also a qualified tuberculosis health visitor and the other



has received training in *x*-ray and laboratory work), two health visitors, one chowkidar and one sweeper.

The work of the clinic for the years 1937 to 1941 is shown in the following table:—

cases were in the group 'predominately exudative'. Seventy-two per cent of the tuberculosis cases were in the age group 15 to 35, 13 per cent in the group 35 and above, and 15 per cent below 15 years.

TABLE

|   | 1937         | 1938   | 1939         | 1940   | 1941   |
|---|--------------|--------|--------------|--------|--------|
| Total attendance .. ..  | 2,469        | 17,471 | 19,087       | 18,472 | 21,654 |
| New cases—total .. ..   | 711          | 3,736  | 3,925        | 4,079  | 4,292  |
| New cases—tuberculous .. ..                                       | 223          | 711    | 672          | 800    | 862    |
| New cases—pulmonary tuberculosis ..                               | 170          | 546    | 461          | 579    | 568    |
| New cases—abdominal tuberculosis ..                               | 42           | 69     | 128          | 119    | 213    |
| Contacts examined .. ..   | Not recorded | 685    | 1,233        | 1,250  | 1,554  |
| Contacts diagnosed as having active tuberculosis.                 | Do.          | 82     | 113          | 133    | 126    |
| Home visits } by health visitors .. {                             | Do.          | 1,112  | 872          | 723    | 1,495  |
| Homes visited }   | Do.          | 243    | 465          | 453    | 583    |
| Patients sent to sanatorium .. ..                                 | 26           | 37     | Not recorded | 9      | 13     |
| Laboratory examinations .. ..                                     | Not recorded | 3,649  | 3,375        | 2,467  | 2,439  |
| <i>X</i> -ray examinations .. ..                                  | Do.          | 3,899  | 4,704        | 4,941  | 5,474  |
| AP inductions, pleural aspirations, pneumo-peritoneum injections. | 149          | 1,354  | 1,308        | 701    | 1,234  |
| AP cases .. ..  | 24           | 97     | 137          | 105    | 142    |
| Other injections .. ..  | Not recorded | 1,411  | 2,133        | 2,103  | 2,023  |

If the four years are added together, it will be seen that from 1937 to 1941 in our clinic about 17,000 new patients were examined of whom 3,267 were diagnosed as suffering from active tuberculosis. There was a total attendance of about 80,000 at the clinic. Nearly 5,000 contacts were examined and about 454 of them were found to have active tuberculosis. The detection of an active focus thus leads to the detection of more unknown foci. Over 2,000 separate homes were visited and about 5,000 home visits were made by the staff. It is estimated that, in one way or another, we have given personal talks to about 55,000 individuals in these four years.

During the period under review, 11,930 laboratory examinations and 19,018 *x*-ray examinations (mostly fluoroscopy) were done. 4,746 artificial pneumothorax inductions and 3,675 injections were given.

Out of the nearly 3,267 cases of tuberculosis detected, 2,324 were pulmonary cases and 571 abdominal; about 10 per cent were in stage I, 30 per cent in stage II, and 60 per cent in stage III. Roughly, 70 per cent of the pulmonary

### Discussion

We have achieved nothing spectacular in Nagpur. The utmost that we can say is that we are striving towards the establishment of an atmosphere, environment and knowledge which will be unfavourable to tuberculosis. One can show certain number of cases 'relieved', 'arrested' or 'cured', but one can not show the number of people prevented from getting tuberculosis through the influence of the clinic. The spread of the knowledge of the prevention of tuberculosis cannot be gauged by any known measure, and it is too early to show any influence of the clinic on the mortality or morbidity rate of tuberculosis in the city. For that, a more intensive campaign and an augmented and all-embracing scheme is required. But our present work is not in vain, for it is truly laying a foundation on which is going to be built the further development of the fight against tuberculosis in Nagpur.

During the four years we have learnt by experience and we feel that this experience, if passed on to others, may be of use to them.

The still-existing practice of keeping from the patient the fact that he is suffering from tuberculosis is dangerous. Apart from the fact

that by doing so we cannot get his co-operation he continues to remain an uncontrolled focus spreading the infection. It is the patient and his contacts who are primarily concerned in the spread of the knowledge about tuberculosis. 'The efforts against tuberculosis should not be wasted in a general broadcast type of propaganda but should be concentrated and directed to reach those among whom the disease is actually found and to educate them in tuberculosis control' (Dr. P. V. Benjamin). Indeed, every personal talk and every detection of a case goes towards the establishment in society of an environment more and more hostile to tuberculosis. Doctors and health visitors of a clinic who conscientiously strive towards this end need not be discouraged by any seemingly poor immediate results or failure to show any spectacular achievements.

In the education of the patient and the contacts, the health visitors play an important part. While the doctor-in-charge of the clinic should be the brain and heart of the clinic, the tuberculosis nurses should be the sensory and motor nerve endings and the capillaries. When the health visitors fail to do their work properly the clinic is ruined. Therefore, we require health visitors with not only good education but also character and dignity. Such health visitors are not easy to secure. The character and pursuits of the subordinate staff are either inspired or ruined by the character and personality of the man in charge. Thus a great deal of effectiveness of the campaign depends upon the selection and training of its health visitors and doctors.

It is most important that the health visitor and the doctor should din into the patients, day in and day out, information about the following subjects :—

Isolation of the case in the house, disposal of sputum, disinfection of clothes and utensils, necessity of prolonged and continued rest, eating the diet he can afford in sufficient quantity, the prolonged nature of the treatment, and avoidance of pregnancy during and for some years after the treatment. I have found the necessity of speaking specially on these subjects to the patient and contacts unceasingly and untiringly. The patient is apt to think that, as long as he takes his medicines and injections, he has done his job. Effective isolation and organized home treatment are not easy in the average case, but with the co-operation of even the worst situated patient, the spread of the bacilli can be reduced to some degree at least. The advice most difficult for the average clinic patient to follow is to cease work. Most of these are daily wage earners and they and the family have to starve during absence from work. The Care Committee can only touch the fringe of this problem. It is ultimately the responsibility of the State. Even in the best of families, if the bread winner is stricken it proves a serious disaster, and equally so if it is the mistress of the house who is

stricken. The calamity is very serious in the household of my average patient.

We have found that no stratum of society is exempt from tuberculosis, and it is peculiar to no particular occupation, sex or community. Tuberculosis is common in those employed in works where a large number congregate under one roof, as in factories, where the spread of infection is easy. The disease is common among the poor because the housing and other ways of life among them make the people easy targets to the bacilli discharged from the infected persons who inhabit their environment and dwellings. It is common among the rich because often their way of life is no better than that of the poor. Most of the communities in the cities live, more or less, under similar conditions, and the incidence of the disease among them is not dissimilar.

No difficulty has been found by us, on the whole, in getting proper reception during home visits and in getting a sufficient number of contacts for examination. There have been unpleasant incidents but only few and far between, and not serious. Work in this direction is only limited by inadequate staff. But for this limitation, it would be possible to visit almost every house and bring for examination almost every contact.

The clinic has been able to obtain the co-operation of the private practitioners and other bodies. Co-operation depends most of all on the character, honesty and sincerity of purpose of the staff of the clinic—granted which the winning of adequate co-operation is only a question of time. Especially the doctor in charge should be endowed with sufficient knowledge of his work and should prove a constant source of real help to his fellow doctors. Above all, his status and salary should be so placed that he never needs to enter into unseemly or undignified competition with the general practitioner.

One of the most valuable parts of the clinic's work is the giving of artificial pneumothorax treatment. This treatment not only considerably reduces the period of 'rest' for the bread winner, but stops or reduces the output of bacilli in many cases. Its importance is great when we realize the careless habits of the average public. In the clinic, cases often can continue with profit the artificial pneumothorax for years without any handicap to their vocation. We are finding, as the years go by, that we are getting more and more early cases, and also that cases under treatment realize the importance of prolonged treatment and years of aftercare.

During the last four years only about hundred cases could secure admission to sanatoria and only a few others to hospitals; but the majority of our cases are acutely ill and require hospitalization for a shorter or longer period. Herein lies the necessity for more beds in the clinic and need for town—'sanatorium—hospitals'. The

beds in the clinic-ward should keep patients until they become 'apyrexial' or otherwise 'ambulatory'. It appears that climate plays only a secondary part in the 'relief' or 'cure' of tuberculosis. My opinion is that expert treatment, combined with other essential conditions like rest, diet, etc., can produce almost as good a result in the town as in sanatoria situated in ideal climates. This does not belittle the sanatoria, the advantages of which I cannot discuss here.

As I said earlier, the population of Nagpur is about three lakhs. The population administered by the tuberculosis scheme of the county of Lancashire in England is about 20 lakhs. The County Council of Lancashire runs 8 tuberculosis centres each with a team of whole-time doctors, one large sanatorium of 226 beds and 5 smaller ones, and has 33 health visitors and adequate expert clerical staff. It has a total of 981 sanatorium-hospital beds and spends £105 per 1,000 of the population for the prevention and treatment of tuberculosis. The death rate of tuberculosis in 23 years, less than a quarter of a century, has declined by 52 per cent. It is really impressive, but not achieved without adequate expense and effort. The motto of Lancashire is 'find, isolate, educate and treat'.

What has been done in Lancashire shows how far behind we are in Nagpur and how much we have to do. The common argument is that we cannot, in this country, afford to conduct the campaign on the scale on which it is conducted in other countries which have controlled tuberculosis. Unless we too can expend as much, we can make no such progress. I believe we have the resources in men, money and material to wage this war and win it.

This paper is not the result of any survey, and it is far from a complete report of the work of the clinic. I have just reviewed my reactions to the last five years' work which is on the simple basis that tuberculosis is a curable disease and a preventable disease, that the front of the fight against tuberculosis is in the home of the patient, that the study and care of the patient is the beginning, but from it the desired end is attainable or control of tuberculosis.

I am grateful to the civil surgeon Major Kelly, the inspector-general of civil hospitals Col. Hance, and the provincial Government for their permission to publish this article.

## A Mirror of Hospital Practice

### A CASE OF IMPERFORATE HYMEN

By NANASAHEB CHATE, L.C.P.S.

Subsidiary Medical Practitioner, Belavdi,  
District, Belgaum

A GIRL, aged about 22 years, was brought to the rural medical dispensary at Belavdi for the treatment of retention of urine and colicky pain in the abdomen.

*Examination.*—A mass, globular in shape and of woody consistency, could be felt rising out of the pelvis and extending to about six fingers above the umbilicus. On auscultation nothing but a gurgling noise here and there was heard.

A second mass of about the size of a small coconut was found between the thighs, and pressure on the mass in the abdomen made the lower one more tense. The labia were stretched out and the urethral orifice was pressed to the size of a pin-hole. The position of the vaginal orifice could not be made out.

*History.*—On enquiring into the history of the case I found that she had felt pain in the abdomen every month lasting for about 4 to 6 days since her fourteenth year of age. She first saw the lower mass when she was 16 years old, and it grew from below upwards up to its present size. She did not consult anybody through shyness. She could not pass urine for the last twelve hours.

*Operation.*—After an unsuccessful attempt to pass a long-sized female catheter I made a vertical incision starting from just below the urethral orifice. After going about quarter of an inch deep thick tarry blood came out with the gradual disappearance of the mass. The total quantity of the fluid withdrawn was six pints. The hymen was then snipped off and a vaginal douche with Condy's fluid given. The patient passed urine herself after the disappearance of the mass. She is now menstruating regularly.

## SULPHANILAMIDE PACKING IN THE TREATMENT OF COMPOUND FRACTURE

By JAGADISH C. BHATTACHARJEE, L.M.P.

and

LALIT C. MAJUMDER, L.M.F., L.T.M.

D. H. Railway Hospital, Tindharia, Darjeeling

A NEPALI WOMAN, aged 46 years, was admitted on 11th January, 1942, for the treatment of a compound fracture of both ulna and radius about two inches above the left wrist joint. It was reported that she had a fall of about 30 feet from the hillside.

On examination, a large gaping wound was found, situated transversely on the site of the fracture, from which blood was dribbling. The proximal extremity was found to be loosely adherent and displaced on the dorsal aspect.

*Treatment.*—The wound was cleaned, two grammes of sulphanilamide powder was introduced, was packed with gauze, and the limb secured in a splint. The patient was put under morphia.

Next morning the dressing was found to be soiled by blood, and was changed. Two grammes of sulphanilamide powder was placed within the gaping wound and the limb secured in the splint.

The dressings had to be changed again next morning as the oozing continued. Another two grammes of sulphanilamide powder was put into the wound and the part immobilized. After that, as little bleeding was evident, the limb was not disturbed till the twenty-second day, when the dressings and the splint were removed. The wound was found to have healed up by first intention with a good union of both the broken bones. Besides this treatment, the patient was given 1.5 grammes of sulphanilamide by the mouth during the first two days.

We are grateful to Dr. S. K. Biswas, medical officer, D. H. Railway, for his kind permission to report this case.

# Indian Medical Gazette

OCTOBER

## ANTI-TUBERCULOSIS WORK IN INDIA

THE seriousness and magnitude of the tuberculosis problem attracted the attention of various workers in India in the early years of the present century. The establishment of the King George Thanksgiving (anti-Tuberculosis) Fund was a natural sequel to the work that had been carried out in the preceding quarter century. The establishment of the Tuberculosis Association of India, through the untiring efforts of Her Excellency the Marchioness of Linlithgow, consolidated the position still further. Finally, the affiliation of 14 provincial and 13 state tuberculosis associations to the central body is evidence of the keenness and sincerity of the interest which the people in all parts of India are taking in the matter.

As a result of the drive carried out by the Tuberculosis Association of India, a large number of clinics have already been started in various parts of India, beds have been added to existing institutions, and new institutions have been started to accommodate both infectious and 'closed' cases which are not suitable for treatment in the home. The work done at these clinics indicates that a large percentage of new cases, particularly among the children and adolescents, originate from contact with previous known or unknown cases of tuberculosis, and the need for early detection and treatment of the 'open' case is being increasingly felt.

An important measure that has recently been completed has been the fixing of standards for classification of pulmonary tuberculosis, and the laying down of the principles and methods for tuberculosis survey in different parts of the country; this has been achieved with the help of the Indian Research Fund Association.

Properly conducted surveys are an essential preliminary to any large scale attempt at control of tuberculosis, and those already concluded are likely to yield valuable information to the administrative authorities planning the control measures in different areas. We need information not only about the incidence and types of the disease encountered in rural, urban and industrial areas, but also about the mode of infection and spread of tuberculosis in the community. It is generally accepted that when an agricultural country becomes industrialized, the incidence of tuberculous disease and deaths increase, until it is controlled by raising the standards of living and improving the sanitation of the environment, the keystone of which is the solution of the housing problem.

While tuberculosis mortality has been steadily declining in many industrialized countries, there

is strong evidence to suggest that at present it is increasing in India. As India is on the threshold of extensive industrialization and as the large majority of the workers will have to be drawn from rural areas, this is the moment for research workers and administrators alike to concentrate their full attention on the subject of tuberculosis in relation to industry. Suitable measures introduced now may prevent history repeating itself in this country and it may be possible to save the growing industrial populations from at least some of the disasters that overtook them in other countries.

The war has brought with it new problems with regard to tuberculosis. It is essential therefore that we should not allow the present situation to be used as an excuse for neglecting the tuberculosis problem, but should insist that our efforts are redoubled to face the many new aspects that it presents.

It is a well-known fact that both morbidity and mortality from tuberculous disease rise in war-time. For this, there are many causes; these include increased physical and mental strain, privations, ill-spent leisure, over-crowding, and increased opportunities for contact with sources of infection. This increased morbidity and mortality from respiratory diseases in general and tuberculosis in particular was experienced in every country involved in the 1914-1918 war, and is in evidence again during this war. In England, deaths from respiratory diseases showed increases of 6 per cent in the first year of war and of 10 per cent in the second year, as compared with the last pre-war year (ending mid-1939). The probable rise in tuberculosis in India, as in other countries, is therefore a special war-time problem which should be tackled with the sense of urgency that is being given to other war-time problems.

X-ray examination of the chest is a very valuable method of conducting tuberculosis surveys, as it is practically the only means by which symptomless cases can be detected. Hitherto this method of examination was not only costly, but also time consuming; recently however the introduction of miniature radiography has reduced both these factors and has made it possible to examine, at a comparatively small cost, large numbers of persons, e.g. school and university students, the staff of commercial firms and government offices, and groups of recruits for the army, the police, and labour forces. This method is being used increasingly in most of the advanced countries in the world, and, in India, recruitment authorities for the services, commercial and industrial concerns, and big employers of labour, such as the railways, tramways, etc., would do well to consider adopting this method for weeding out active or potential tuberculosis cases from amongst their prospective or established employees.

The tuberculosis programme sponsored by the Tuberculosis Association of India will not achieve

its objectives unless the governmental agencies collaborate fully with the various social welfare agencies already operating in the country, and unless the work is co-ordinated with the public-health programme of the country. The campaign should be as broad based as possible in order to ensure success, for one should not forget that tuberculosis is a social disease and therefore needs a social drive to eradicate it.

The present issue of the *Indian Medical Gazette* constitutes the 6th special tuberculosis number. It will be seen that, like its predecessors, this issue presents papers covering a wide field, including epidemiology, pathology, diagnosis, and treatment. It is hoped that its publication will stimulate other workers to define and investigate other urgent important problems regarding the disease. Continuous research is an essential adjunct to any successfully planned tuberculosis campaign, and nowhere is the need for it greater than in India where many major problems still remain unexplored.

The papers for this number were collected and selected by an editorial committee of the Tuberculosis Association of India which consisted of Dr. A. C. Ukil, Dr. P. V. Benjamin and Dr. Sikand.

Space did not however allow the inclusion of all the papers selected and two papers\* have been held over for our next issue.

Our thanks are due to the editorial committee for their co-operation, and particularly to Dr. A. C. Ukil who has ungrudgingly assisted with his expert advice in the solution of many problems that inevitably arise in the publication of technical papers.

#### P. A. MAPLESTONE

READERS will perhaps notice that the familiar name of Dr. Philip Alan Maplestone, D.S.O., D.Sc., M.B., Ch.B., D.T.M., does not appear this month on our cover. Earlier in this year, when the Japanese threat to Australia was developing rapidly, Dr. Maplestone decided that in the circumstances he ought to return to Australia where his wife and family were living. He took four months' leave, but since his arrival in Australia he has resigned his appointment at the School of Tropical Medicine in Calcutta and also the assistant editorship of this journal.

Dr. Maplestone was in government service in the Northern Territory of Australia from 1909 until he joined the Australian Army Medical Corps in 1915. He served in France and elsewhere with distinction, being mentioned in dispatches and receiving the D.S.O. After the war, he left the army with the rank of major.

He took his D.T.M. at the Liverpool School of Tropical Medicine in 1919, and returned to Australia to an appointment at the Australian Institute of Tropical Medicine, Townsville. From 1921 to 1924 he was assistant director of the Sir Alfred Jones' Laboratory, Sierra Leone, West Africa. Later, he was appointed lecturer in protozoology at the Liverpool School of Tropical Medicine.

By this time he had already begun his work on systematic helminthology and he described many new species of tapeworms in a series of notes on Australian cestodes, often collaborating with Dr. Southwell. He also made some important observations on the development of hookworm larvæ and explained the natural control of hookworm infection in some particular areas. His paper on the revision of the classification of Amphistomes of mammals helped to clear up a long controversy as to the validity of numerous families and species of these trematodes. In collaboration with Dr. Warrington Yorke he wrote *Nematode Parasites of Vertebrates*; this book has simplified the identification of nematodes and has been accepted as a standard work of reference by helminthologists all over the world.

He was appointed a research worker at the School of Tropical Medicine, Calcutta, in 1927. Here he continued his work on systematic helminthology and contributed many important papers on the practical aspects of hookworm and ascaris control. He was largely responsible for broadening the basis of the helminthological research and virtually founded the helminthology department at the School. He always had a leaning towards clinical medicine and in order to enlarge his scope he studied skin diseases under the late Colonel Acton, and later took his place as officer-in-charge of the skin diseases department. He contributed many important papers, both theoretical and practical, on this subject. During his last year at the School, he also undertook the teaching of helminthology to the students of the L.T.M., the D.T.M., and the D.P.H. classes.

Dr. Maplestone has been assistant editor of the *Gazette* for nearly ten years. He joined the staff at the beginning of 1933, when the late Colonel Knowles resigned on account of ill health. His extensive knowledge of parasitology and tropical medicine in general, his well-developed critical faculty, and his readiness to take endless trouble to get the best out of a badly constructed paper were qualities that made for success in editorial work. As an associate, the writer found him extremely helpful, entirely reliable, and very stimulating. His complete mental honesty and direct 'Australian' way of calling a spade a spade, which sometimes offended those who did not understand him, appealed particularly to the writer and in his opinion made Dr. Maplestone an ideal associate.

Dr. Maplestone's departure is a great loss to the School and to this journal, but, as he left

\*An Investigation into the Incidence and Type of Tuberculous Infection in Cattle at Amritsar with Special Reference to Human Infections. By S. M. Mallick, Major, I.M.S., R. S. Dr. Het Aggarwal, M.D., Dip. Bact. (Lond.), and Ram Lal Dua, M.B., B.S. On Pulmo-circulatory Dysfunction in Lung Tuberculosis. By K. Eisenstaedt, M.D., D.D., and A. U. Rindani, M.B., B.S.

sound in wind and limb and with his mental faculties at their highest point, India's loss will be Australia's gain. We sincerely hope that he will find suitable scope for his energies and abilities.

Dr. John Lowe, M.D., who succeeds Dr. Maplestone, has an international reputation as a leprosy worker. He has had many years' editorial experience as editor of *Leprosy in India*, and will, we are convinced, prove a worthy successor to Dr. Maplestone.

## Medical News

### AUXILIARY NURSING SERVICE: RECRUITMENT TO BE RESUMED FROM OCTOBER

RECRUITMENT to the General Service category of the Auxiliary Nursing Service, India, which had been suspended temporarily pending the revision of the terms and conditions of training, will be resumed from October. Under the revised terms, candidates will receive a preliminary training for 3 to 9 months in certain selected civil hospitals throughout the country, provided that their services are not required in the meantime for military duty. During training the candidates will be provided with free accommodation and board in the hospital and will receive a small personal allowance in addition.

The lady district superintendents of the St. John Ambulance Brigade Overseas will, as usual, act as the recruiting agents.

### IMPROVED METHODS FOR MALARIA CONTROL FOR CANTONMENTS

WITH the drive against malaria now being organized by the Army authorities, most of the cantonments in India will be free of the disease. The campaign which is expected to cost about Rs. 16 lacs will involve the expansion and reorganization of the existing anti-malarial measures.

Under the new scheme emphasis will be laid on co-ordinating anti-malaria methods in various stations. Mobile personnel will carry out operations throughout the year. These will not only benefit the military, but also the neighbouring civil population. With the collaboration of the civil and military authorities, the scheme may eventually form the nucleus of a drive against the disease in towns and villages as well as in military stations.

A special organization is being set up under an officer of General Headquarters who will be assisted by a body of doctors and scientists specially trained for the work. Each station will be under the supervision of an anti-malaria officer and an assistant each of whom will receive special training at the Malaria Institute of India. Similarly a large number of insect collectors are being recruited who will also undergo a course of training at the Institute.

The organization will be armed with modern equipment to fight malaria. They will have electric sprayers, petrol-driven sprayers, knapsack sprayers, blowers and mixers and will be provided with lorries and bicycles. The ammunition of these malaria fighters will include thousands of gallons of pyrethrum extract, malariol and paris green.

Although a great reduction in the incidence of malaria in the Army in India has occurred during the last 15 years, the rate still remains high. In 1940 total admissions to hospital per thousand of strength were 73.4 for British troops and 173.2 for Indian troops.

Any further reduction in the ratio is considered impossible with the existing arrangements, but it is confidently expected to occur once the problem is tackled on improved lines.

### GENERAL LIM

A CELEBRATED London physician once said, 'The medicine of ten years hence is to be found in the pages of the *Journal of Physiology* of to-day'. Anyone turning over the pages of that high technical magazine for the year 1894 will see an historic paper on the killing of germs in the blood, by Hardy and Lim Boon Keng. Lim Boon Keng was the father of Professor Lim—now Lieut.-General Lim, Commander of the Chinese Army Medical Service, whose headquarters are at Kweiyang, in Kweichow province.

Lim, following the family tradition, took up physiology and medicine as a life's work. He was educated at Watson's College, Edinburgh, and later at Edinburgh University, where he took a prominent part in the life of the Students' Union, and in many other University activities. By reason of his modest and genial personality, coupled with his obvious ability, he was a universal favourite.

His work in the physiological department at Edinburgh, then the realm of Sir Edward Sharpey Schafer, commenced in 1919, and in 1921 he received the definite appointment of Lecturer in Histology, a subject in which Lim's artistic ability showed itself in his beautiful drawings of microscopic structures. In 1924 Lim left for China to become Director of Research and Professor of Physiology in the new Medical School to be started in Amoy. Actually, that project never materialized, but he was appointed Professor of Physiology at the Peiping Medical School.

In Edinburgh, Lim's research dealt principally with the structure and functions of the digestive glands in the stomach—a field which led him to research on the transplantation of organs, and the artificial suture of vessels, and ultimately into a study of the sympathetic system, a career which recalls that of the late Professor Langley.

Lim's influence on science in China, and indeed far beyond China, is not to be measured simply by the catalogue of his own papers. Naturally a leader, he was one of the original editors of the Chinese *Journal of Physiology*, and one of the Founders of the Chinese Physiological Society. His department must be accounted one of the important physiological laboratories of the world.

[General Lim recently visited India.]

### INDIA-MADE SURGICAL INSTRUMENTS FOR RUSSIA

NEARLY 80,000 surgical instruments manufactured in India have been supplied to the Indian Red Cross Commissioner for despatch to Russia. This was revealed at the 7th meeting of the Medical Stores Supply Committee which met in New Delhi on 10th July, with Lieut.-General Sir Gordon Jolly, Director-General, I.M.S., in the chair. A representative of the drug manufacturers in India has now been included in the Committee.

Reviewing the progress of medical stores manufacture in India, the Committee noted that during the last six months 133 items have been transferred to the list of medical store articles now made in India. Marked progress has been made in the production in India of acriflavine, atropine sulphate, catgut ligatures, tannic acid, creosote and ephedrine.

There have been important developments in the manufacture in India of surgical instruments and appliances, both as to variety and quantity, and the gross output of the industry has increased tenfold within the past twelve months. For example, one million 'Suture' needles were manufactured during six months ending with May 1942, and the production of six million more over the next 12 months has been planned.



### Waste of quinine

The position of anti-malarial drugs in India, particularly quinine, was reviewed by the Committee. The desirability of enlisting the aid of the medical profession in India in preventing waste of quinine in the treatment of malaria was strongly urged. The Committee noted the recommendation of the Malaria Commission of the League of Nations that the standard course of treatment for malaria should consist of 15 to 20 grains of quinine daily for five to seven days. It was agreed that if medical practitioners in general followed this rule, much waste would be avoided.

### VEGETABLE INSECTICIDES IN INDIA

THE discovery of several useful vegetable insecticides and the possibilities of their cultivation in India are revealed in a leaflet (No. 20) just published by the Forest Research Institute, Dehra Dun.

For controlling agricultural as well as household pests vegetable insecticides are preferred to others, such as lead and copper salts, arsenic and nicotine, because they are non-poisonous to man and animals.

The growing demand for vegetable insecticides was hitherto met mainly by a plant called 'derris' from Malaya, Dutch East Indies and Philippines. Investigations conducted by the Forest Research Institute have now shown that other plants bearing the same toxic content as 'derris' are available in this country; and the existing materials are rich enough for the preparation of effective insecticidal emulsions and powders. Their toxic content is capable of still further improvement by proper cultivation and treatment.

Certain parts of India, it has been found, possess suitable climatic and soil conditions for the introduction and cultivation of richer varieties of Malayan 'derris'. Experiments in this direction have already proved successful in Mysore, Cochin and Assam.

### INDIAN MEDICAL SERVICE RECRUITMENT

As a war-time measure, the Government of India have decided that medical practitioners who hold the following qualifications will be eligible for appointment to the Emergency Cadre of the Indian Medical Service:—

1. Bachelor of Medicine and Bachelor of Surgery of the Mysore University (M.B., B.S. Mysore).
2. Bachelor of Medicine and Bachelor of Surgery of the Osmania University (M.B., B.S. Osmania).

### ADVANCE OF PAY FOR I.M.S. OFFICERS

THE Government of India have decided that candidates selected for Emergency Commission in the Indian Medical Service for duty within Indian limits may be granted an advance of pay not exceeding Rs. 300 at the time of appointment.

The advance will be recovered by monthly instalments of one-third of his pay.

### GROUNDNUT AS HUMAN FOOD

(Note issued by the Nutrition Research Laboratories, I. R. F. A., Coonoor)

GROUNDNUT (*Arachis hypogaea* Linn) is really a leguminous plant, although in their chemical composition groundnuts resemble nuts such as cashew, almond and walnut more closely than they resemble pulses. The plant is a native of Brazil, from whence it spread to Africa and Asia. It has been cultivated in the tropics and sub-tropics for several centuries, and in India groundnut is an important crop. It is grown chiefly in Madras, but Bombay and the Central Provinces are also important centres of production. In normal times groundnut oil and cake are exported in large quantities to the United Kingdom and the continent of Europe. As a result of the war, exports

from the Madras Province dropped from 760,000 tons in 1938-39 to 282,000 tons in 1940-41.

The reduction of the export trade has produced a disposal problem. One method of disposal would be its wider use as human food and this raises the question of its nutritive value. Per 100 grammes, it contains about 25 to 33 grammes of protein, 40 to 50 grammes of fat and 10 to 20 grammes of carbohydrate. It is rich in phosphorus, but not in calcium. As regards its vitamin content, it contains some of the B vitamins, notably B<sub>1</sub> and an important member of the B<sub>2</sub> group, nicotinic acid, in fair amounts, but no vitamin A. Groundnut oil, like most vegetable oils, is devoid of this valuable constituent. Vanaspati or vegetable ghee, which is usually made from groundnut oil, does not contain fat-soluble vitamins A and D.

### Experiments with groundnut

In the Coonoor Laboratories a long series of experiments has been carried out on the value of various foods in 'supplementing' poor rice diets. Rats are given a diet which resembles in composition poor rice diets eaten by human beings. Different foods are added to this basal diet and their effect on the development of the rats observed. This method of testing provides a good idea of their nutritive value under Indian conditions. In fact it is in some ways a better index than detailed chemical analysis. If milk is added to the rice diet, the result is a striking increase in the growth rate and an improvement in the general condition of the animals. Groundnut, however, when given in amounts equivalent to 1 to 2 ounces daily in a human diet, does not produce any striking supplementary effect. The conclusion is that groundnut, although it is rich in certain food factors, does not contain enough of the constituents which are most needed by the poor rice-eater to make good the defects of his diet. Milk, on the other hand, contains these in the correct proportions. It is possible that the relatively low calcium content of groundnut is to some extent responsible for its failure as a supplement and its deficiency in certain vitamins in the B<sub>2</sub> group may also be concerned. Experiments on this subject are proceeding.

Suppose half to one ounce of groundnut were distributed daily to poor children in schools. It is not to be expected that such a supplement would be as effective in improving their state of nutrition as a glass of milk. On the other hand, groundnut, taken in small quantities, is perfectly good food. Its high fat content makes it a concentrated food, with a high caloric yield per unit of weight. Since many poor school children are under- as well as mal-nourished, any supplement which increased their total food intake would be of value. In normal times peanuts sold very cheaply in small paper bags are very popular among poor children in London.

Groundnuts as such have never been used as a staple human food anywhere in the world. Consumed in large quantities they tend to be nauseating, probably because of their high fat content. Their main use has always been as a source of oil, the 'cake' which remains after the extraction of oil being employed as cattle food and manure. It is said that groundnut cake is used as human food in Spain. In the U.S.A. so-called 'peanut butter' has been fairly widely consumed, and in that country roasted peanuts are very popular. The inclusion of groundnut flour in small quantities in wheat biscuits has been suggested.

The idea that groundnuts could be used in India as an important article of diet, replacing equivalent quantities of cereals such as rice, may be dismissed. They could, however, be consumed in somewhat greater quantities as an addition to ordinary diets, either in the form of roasted nuts or as a sweetmeat with jaggery. Even a slight increase in consumption would help to dispose of surplus stocks. In the present circumstances it is unfortunate that they cannot be strongly recommended by the nutrition worker as an exceptionally valuable food, but there is no reason why their use as human food should not be extended.

## Public Health Section

### A NOTE ON A TUBERCULIN SURVEY IN SIALKOT TOWN

By C. L. SAHNI, M.B., B.S. (Punjab), D.P.H. (Lond.),  
D.T.M. & H. (Eng.), L.M. (Dub.)

*Municipal Medical Officer of Health, Sialkot*

At present our knowledge of the incidence of tuberculosis in India is meagre; one of the ways of getting knowledge as to the extent and distribution of tuberculous infection is by means of carrying out tuberculosis surveys, of thousands of persons. This fact was emphasized by all the tuberculosis workers who attended the tuberculosis workers' conferences, held in Delhi in 1939 and 1940. It was also decided at the conferences that a uniformity should be maintained in the method of planning and conducting the surveys in the whole of the country. In India, the survey work done has been small and inadequate considering the vastness of the problem of tuberculosis in the country, where millions of open cases exist.

It was decided by the writer in the middle of 1940 to start a tuberculosis survey in Sialkot town under the auspices of the District Red Cross Society. To begin with, it was decided to conduct a type I survey (*i.e.*, a tuberculin survey) on the lines suggested in the report of the tuberculosis survey sub-committee of the Indian Research Fund Association. It was not, however, till the beginning of 1941 that the actual work could be undertaken.

Sialkot town is situated in the north of the Punjab, and has a population of 119,723 according to the census of 1941. It is an industrial town and some portions are very congested. It is specially known for its sports goods industry.

#### *Object of the survey*

The survey was conducted to ascertain by means of the tuberculin test the extent and distribution of tuberculous infection amongst boys and girls, belonging to different nationalities, in different age groups, and residing in different areas of the city.

*Number of persons tuberculin tested.*—Six thousand four hundred and thirty-six children, 3,455 boys and 2,981 girls, studying in thirty-two schools in the town were tested. The children to be tested were not selected in any way; all the children of both the sexes and of ages between 5 and 18 years were tested. All communities, Muslims (4,143), Hindus (2,028) and Christians (265) were included. About 95 per cent of the children belonged to the urban areas, and only 5 per cent came as day-scholars from the neighbouring villages.

#### *Technique*

The method used for the tuberculin test was that of Mantoux, as the results with Mantoux's intradermal test are more accurate than with the other tests. Burroughs Wellcome & Co.'s old tuberculin human (T) was employed in this

investigation, normal saline was used as diluent, and 0.1 c.cm. of the dilutions used contained the desired dose. Tuberculin solution was always kept in a refrigerator, and was never employed when more than ten days old. The field-workers carried the tuberculin solution in cool thermos bottles, and were supplied with special tuberculin syringes.

*Dilutions.*—Dilutions employed were 1 in 1,000 and 1 in 100. 1 c.cm. syringes graduated 1/20 c.cm. were used. The needles after each injection were merely wiped with cotton-wool soaked in absolute alcohol.

*Site of injections.*—The site of injection selected was the front of fore-arm after it was cleaned with spirit and was dry.

*Dosage.*—All the children were first tested with 0.1 c.cm. of a 1/1,000 dilution, a second test was done with 0.1 c.cm. of a 1/100 dilution in those who gave a negative result with the first dose. The results were read at the end of 48 hours, and again at the end of 72 hours, when the final opinion was recorded by the investigator.

The degrees of intensity were recorded according to the following standards:—

- |                  |  |
|------------------|--|
| One plus (+)     | = Slight but defined œdema raised 1 mm. above skin surface and not more than 10 mm. in diameter in the largest axis.   |
| Two plus (++)    | = Well-defined œdema, raised somewhat more than 1 mm. above skin surface; diameter between 10 to 15 mm.  |
| Three plus (+++) | = More extensive œdema with diameter exceeding 15 mm. and thickness exceeding 1.5 mm. above skin surface; wide area of redness beyond but no vesiculation or necrosis of the skin. |
| Four plus (++++) | = Extensive œdema, redness, vesiculation and necrosis; may be associated with temperature and malaise.   |

Mantoux tests were not started till propaganda had been carried out amongst the public, teachers and the children, and it was felt that there would be no opposition from the public. The managing committees of the various schools had to be addressed and the members were individually as well as collectively informed about the object of the survey and its advantages to the community. The tests, however, could not be done in two institutions, as it was not possible to secure the co-operation of the managing committees of the schools. The reason was that one or two members on the managing committees

were homœopath doctors who in spite of repeated discussions with the writer were not convinced of the utility of the survey.

#### *Staff and equipment*

The staff conducting the survey worked in conjunction with the doctor-in-charge of the tuberculosis clinic, where a properly equipped bacteriological laboratory was also provided. The tuberculin solutions were prepared in the laboratory under the supervision of the tuberculosis medical officer, and supplied to the investigator. The following staff was employed to carry on the survey: one whole-time woman doctor holding L.S.M.F. qualifications for the girls' schools, one male doctor with L.S.M.F. qualifications for the boys' schools, one typist clerk and one female peon.

Special schedule cards as recommended by the survey sub-committee of the Indian Research Fund Association were used for recording the findings, so as to permit of sorting, tabulation and analysis by modern statistical methods in order to assess the significance of the data obtained.

*Finances.*—The expenditure for the survey was met out of the grant-in-aid of Rs. 2,400 given by the Punjab Branch of the Tuberculosis Association, and the grants from the Sialkot Municipality, and the District Red Cross Society.

#### *Analysis of the findings*

The results of the tuberculin survey, as given in table I, show that the percentage of

Table III gives the results of the tests in the different communities, and according to the intensity of the reaction.

Amongst the Muslims and Indian Christians the incidence of positive results is 36.7 per cent and 35.0 per cent; amongst the Hindus the incidence is much lower, only 27.0 per cent.

The purdah system and other social habits among the Muslims probably increase the chances of tuberculous infection, and cause higher percentage of positives in this community.

It is of some importance to note the intensity of reaction. It will be seen from table III that 25.8 per cent of the positives are (+), 5.7 per cent are (++), and 1.7 per cent (+++), and 0.3 per cent are (++++). As regards community if we group the three stronger reactions together, Muslims have as many as 56.3 per cent of the strong reaction, while Hindus have 33.9 per cent and Christians 9.8 per cent. The higher percentage of strongly positive reactions among Muslims coincides with a higher percentage of infection rate among them as shown by tuberculin tests.

A correlation of the incidence of positive results in a locality with the sanitary conditions in that locality shows that on the whole the percentage of positives is much less in the children living in relatively less congested and open areas, than in those living in the congested part of the town. However a high incidence of positive tuberculin tests (35.1 per cent) has been

TABLE I  
*The results of tuberculin survey*

| Age periods              | Boys   |           |          | Girls  |           |          | TOTAL  |           |          |
|--------------------------|--------|-----------|----------|--------|-----------|----------|--------|-----------|----------|
|                          | Number | Positives | Per cent | Number | Positives | Per cent | Number | Positives | Per cent |
| Below 10 years           | 1,529  | 364       | 23.8     | 1,164  | 376       | 32.3     | 2,693  | 740       | 27.4     |
| Between 10 and 18 years. | 1,926  | 632       | 32.2     | 1,817  | 793       | 43.6     | 3,743  | 1,425     | 38.0     |
| TOTAL ..                 | 3,455  | 996       | 28.8     | 2,981  | 1,169     | 39.2     | 6,436  | 2,165     | 33.6     |

positives for the whole group of children from 0 to 18 years of age was 33.6, that for children under 10 years of age it was 27.4 and for those between 10 and 18 years it was 38.0.

Table II shows the result of tuberculin tests in boys and girls according to the ages.

The scrutiny of table II shows that the percentage of positives is lowest (17.7 per cent) in the lowest age group (5 to 6), and increases in higher age groups to about 40.8 per cent. It is also seen that girls have a higher percentage of positives in all age groups than boys. This may be due to the fact that girls are in contact with cases of tuberculosis in the homes for longer periods than the boys, as they lead indoor lives for longer periods.

found in a school in spite of the good sanitary conditions.

It is a residential school, and all the girls reside in the boarding house attached to the school. The school building is very sanitary and several acres of land are attached to the school, which is surrounded on all sides by agricultural lands. Most of the girls come from the villages, and it is worth investigating further why such a high percentage of positive reactions is seen in these girls.

Having completed type I survey, it would be interesting to watch the results of type II survey, which it is proposed to conduct in the town with a view to finding out the incidence of morbidity and mortality from the disease. The

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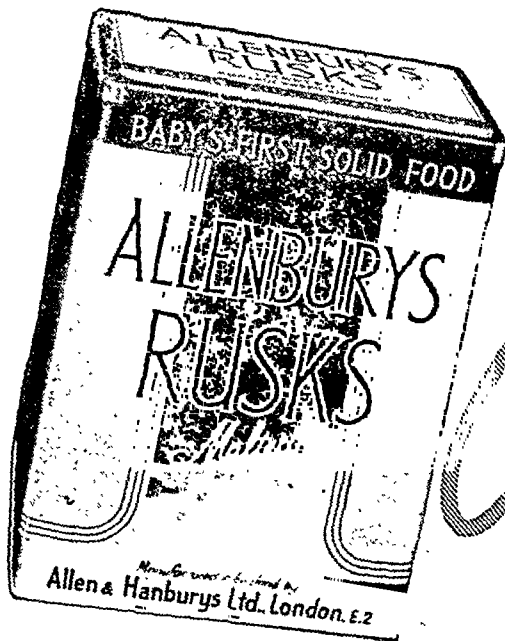
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should be admitted and cared for. These patients should stay in the hospital until the sputum becomes bacillus free or until they succumb to the disease. Another advantage of a hospital is that it provides accommodation for those sputum-positive cases who have no families. We shall thus have a complete and permanent control over 1,000 sputum-positive cases, which if treated and cared for under our present existing unsatisfactory and half-hearted measures, would spread infection in the city, and remain a source of great danger and peril to the public. If our permanent control over 1,000 sputum-positive cases proves successful, there should be no difficulty in increasing the number of health chawls to accommodate all our sputum-positive cases, under the direct supervision of our clinics.

We are spending lakhs of rupees on propaganda, education, clinics, sanatoria and hospitals, but with our present methods, are we seriously controlling the spread of infection? It would be more honest to confess that our present methods give these poor sufferers nothing but false hope and a false sense of security. A sputum-positive case stays in a sanatorium or hospital for a few months, considers himself cured on discharge, goes back to his family, breaks down in a short time, and infects his family as well as other members of the public. This vicious circle is repeated again and again. What good have we done to the patient, the family, the public and even the state by keeping such patients for brief periods in our institutions? Immediate, energetic and radical reforms are needed in our anti-tuberculosis campaign, if this deadly infection has to be exterminated. Organized health chawls, by providing permanent isolation of sputum-positive cases under constant medical supervision, and by combating poverty, overcrowding and undernourishment, offer the only hope of stamping out this scourge from our congested cities.

## Current Topics

### The Influence of Dietary Calcium and Phosphorus upon Tooth Formation

By W. E. GAUNT

and

J. T. IRVING

(Abstracted from the *Journal of Physiology*, Vol. XCIX, 20th December, 1940, p. 18)

THE persistently growing incisors of the rat have long been used for research on the metabolic changes in teeth induced by diet. In the present report the investigation was concerned with the effect produced by a variation in the Ca and P elements in the diet upon the structure of these teeth. It has been found that the rat incisor replaces itself every forty days and this fact is valuable for judging the effect of any change in diet over a certain experimental period. To

a basal diet, calcium lactate and disodium hydrogen phosphate were added in certain proportions; the basal diet contained calcium 0.028 per cent and phosphorus 0.066 per cent. Calcium lactate and  $\text{Na}_2\text{HPO}_4$  were added in different proportions to form the twelve diets in the three experiments. The diets containing the largest amounts of Ca and P, either in proportion of 1.0 or 0.5, developed normally calcified bones and teeth. The rats were divided into four groups, all litter mates; all lived to 70 days except one group with the lowest Ca + P intake in which one rat died of pneumonia, whereupon the other three were killed for examination at 49 days of age. Of the other groups the rats with lowest Ca + P intake were stunted in growth, had a staring condition of the fur and hair and curvature of the thoracic and lumbar regions. There was hyperesthesia on handling accounted for by the discovery post mortem of small beads of callus on the ribs indicative of fracture. The hair was coarse, patches of baldness appeared on the thorax and round the mouth and eyes, more pronounced when the intakes of Ca + P were lowest. No explanation of this is offered. Only two rats showed naked-eye abnormalities of the incisors, such as alternate bands of pigmented and unpigmented enamel; these were on diets low in Ca : P ratios. Chemical analysis showed a low ash content of bone in the diets, poor in Ca and P, but as these elements were increased the percentage of ash rose to almost normal. When the Ca : P ratio was 4, rickets was pronounced. The findings in the teeth were in contrast to those in bone, the weights of ash of the teeth being less affected; this was a more constant fraction of the body-weight than was that of the bone ash. The ash content of the dentine was less affected also. Histological examination showed, however, that the dentine in lower intakes of Ca and P displayed all the changes of deficiency of Ca and P, the predentine not only being much wider than normal but in the inadequate diets contained vascular elements.

Although reduction in the ash of the tooth in poor diets was less than that of bone, calcification of the tooth was more upset than that of bone. From this it is deduced that mineral metabolism of tooth is not comparable with that of bone. The authors refer to chronic fluorine toxicosis in which the ash of the tooth is always lowered while that of the bone is raised or lowered according to the Ca content of the diet, and to Schour, who maintains that calcification of the tooth is an irreversible process. This is contrary to the assumption of some authors that calcium is removed from the tooth during bodily stresses such as that obtaining in pregnancy.

### Current Investigations of the Influenza Problem

By C. H. STUART-HARRIS, M.D., M.R.C.P.

(Abstracted from the *Journal of the Royal Army Medical Corps*, Vol. LXXVII, September 1941, p. 123)

DURING the winter of 1940-41 there was no epidemic of influenza either among the general population or among the service personnel in the neighbourhood of a military hospital. A small increase in the numbers of patients with acute respiratory infection admitted to this hospital occurred in January and February. The majority of the patients had symptoms suggesting clinical influenza and the presence of influenza virus A infection was proved in two ways. Of 8 garglings tested by inoculation of filtrates into the amniotic cavity of 12-day old developing chick embryos, 2 produced either directly or on passage the lesions typical of influenza virus infection. Both strains were readily adapted to mice and then proved to be serologically related to the influenza virus A group. Secondly, pairs of human sera were collected from individual patients during the fever and in convalescence and tested for neutralizing antibodies to influenza virus A. Twenty-seven of 34 pairs of sera



collected in January and February showed rises of antibody to virus A of X 5 or more. The 7 pairs of negative sera showed no rise of antibody to influenza virus B. The correlation between the picture of clinical influenza and the serological change to influenza virus A was good. An analysis of the symptomatology of 60 cases of proven influenza virus A cases from various years showed a uniform clinical picture.

## Reviews

**LECTURES ON AIR RAID INJURIES.**—By The Madura Medical Association. 1942. Published by Mr. N. Krishnamurthy, Honorary Secretary, The Madura Medical Association, Madura. Pp. 106

THIS small handbook contains a series of lectures on air raid injuries delivered by the members of the Madura Medical Association with the object of making knowledge on the subject freely available to the whole medical profession in Madura town. The book consists of two parts, the first of which is meant for wardens and briefly deals with the elements of first aid, while the second part consists of nine lectures on various types of common war injuries, such as injuries of limbs, abdomen, chest, head, ear and eye, and burns. There are also two chapters on shock, and blood and plasma transfusion. Though printing mistakes are common, the book is quite readable and contains sufficient recent information on the subject. It can be recommended to those engaged in ARP work.

R. C.

**THE NATURAL DEVELOPMENT OF THE CHILD : A GUIDE FOR PARENTS, TEACHERS, STUDENTS AND OTHERS.**—By Agatha H. Bowley, Ph.D. 1942. E. and S. Livingstone, Edinburgh. Pp. xvii plus 172; with 84 photographs. Price, 8s. 6d. Postage, 6d.

In an age when the study of the psychology of the child has received in Europe and America an impetus to which few subjects have ever been submitted, it was inevitable that something of high pressure salesmanship should have crept into many of the preparations offered.

The child by some is represented as a battery of high voltage continuously emitting charges often of dangerous strength, and best handled only by the initiated. By others, he is pictured as an amoeba-like mass of sensitive protoplasm, assuming shape and form only from stimuli applied by his environment and contacts.

Miss Bowley's book represents the *via media* and offers a sane and healthy picture of the mental and psychological growth of the child put in language understandable by us all. The author has studied children from birth to thirteen years of age and the book is well illustrated by fine, pointed, photographic studies of the children.

There is an interesting chapter on 'Children and the War'. The effect of evacuation upon the child, and the part to be played by parent and teacher in the maintenance of mental equilibrium by those young citizens, are briefly outlined.

A useful book for students, teachers and parents.

L. G.

**AFTER-TREATMENT : A GUIDE TO GENERAL PRACTITIONERS, HOUSE OFFICERS, WARD-SISTERS AND DRESSERS IN THE CARE OF PATIENTS AFTER OPERATION.**—By H. J. B. Atkins, D.M., M.Ch. (Oxon.), F.R.C.S. (Eng.). Blackwell Scientific Publications, Limited, Oxford. Pp. xiv plus 252. Illustrated. Price, 15s.

THIS book provides a valuable and comprehensive guide to recognized methods of 'After-Treatment'.

Care is taken to stress two important aspects of successful surgery often lost sight of; of primary importance is the need to gain the confidence of the patient by giving him due consideration as a 'person' rather than a 'case'. Also emphasized is the importance of gaining the understanding and co-operation of the ward staff. The book is written in a pleasant easy style that stimulates and holds the interest, and thus should make a special appeal to the busy ward sister or house officer.

D. E. C.

**MATERIA MEDICA FOR NURSES.**—By A. Muir Crawford, M.D., F.R.F.P.S.G. Fifth Edition. 1942. H. K. Lewis and Company, Limited, London. Pp. viii plus 138. Price, 4s. 6d.

THIS little book supplies a very up-to-date summary of the drugs in common use, and would be a most useful possession in all hospital wards, as a reference to enable the nurses to take an intelligent interest in the medicinal therapy of their patients. The new chapter on the control and regulation of poisons provides an essential addition, completing the information required by nurses on this subject.

D. E. C.

**THE PRINCIPLES AND PRACTICE OF OPHTHALMIC SURGERY.**—By E. B. Spaeth, M.D. Second Edition. 1941. Henry Kimpton, London. Pp. 886. Illustrated with 451 engravings, containing 1,149 figures and 6 coloured plates. Price, 48s.

THIS is the second edition of this book and various additions have been made to the text to bring the contents up to date. The author describes the various operations in ophthalmology with which the surgeon has to deal in his everyday practice. Chapters are devoted to anaesthesia; the surgery of the orbit; the lacrimal apparatus; enucleation and allied operations; surgery of the contracted socket; the ocular muscles; reconstructive plastic surgery including epidermal and dermal grafts, mucous membrane, fascia grafts and pedicle grafts; the surgical conditions of the lids; surgical conditions of the conjunctiva, cornea, sclera, iris and anterior chamber. Three chapters are devoted to cataract, in which the author describes the aetiology, differential diagnosis, technique of the various procedures for the extraction of cataract, and the complications of the operation. Three chapters are also devoted to the surgery of glaucoma and two chapters to the aetiology, diagnosis and treatment of retinal detachment. Finally there is a description of injuries to the eyeball, and of x-ray and radium therapy.

To ophthalmologists working in India, the chapters on glaucoma and cataract are of great interest, as these diseases are so common, and large numbers of operations for the relief of these conditions are done. We cannot agree with the author's summing up of the general treatment of glaucoma. For epidemic dropsy glaucoma, it is now agreed that scleroto-iridectomy is the operation of choice, and sclero-corneal trephining has been largely abandoned owing to the frequency of late infection coming on from months to years after the operation; after a unique and big experience of glaucoma operations, the reviewer has no hesitation in saying that late infection and complications are much commoner in sclero-corneal trephining than in sclerectomies; as a routine operation the former is preferred by many experienced ophthalmologists in India. In this we agree with Fuchs who gave up the operation on account of late complications. Every case of chronic simple glaucoma should be judged on its merits. Iridencleisis is not a suitable operation for the average patient in India, and the choice lies between a sclero-iridectomy and a sclero-corneal trephining, and if possible the former should be done. The filtering cicatrix should not encroach on the cornea as it is through the corneal bleb that infection is most liable to occur. The author's description of the various types of cataract operation is good, but we cannot advocate the routine use of conjunctival

sutures; they prolong the operation and complicate the technique. A generous conjunctival flap is preferred, and experienced operators often prefer to make the flap incomplete in the form of a bridge which has many great advantages in cataract work in India. The chapters on reconstructive ophthalmological plastic surgery are excellent.

The book as a whole is first class and contains a mass of practical and valuable information. It is written in a simple clear style and is admirably illustrated with 451 engravings containing 1,149 figures and 6 coloured plates.

We strongly recommend it as being most useful for medical men in India interested in ophthalmology.

E. O'G. K.

**THE PRINCIPLES OF ANATOMY AS SEEN IN THE HAND.**—By Frederic Wood Jones, D.Sc. (Lond., Adelaide and Melbourne), F.R.S., F.R.C.S. Second Edition. 1941. Baillière, Tindall and Cox, London. Pp. x plus 418, with 144 illustrations. Price, 25s.

The second edition of this book is not only a welcome addition to works on the hand, but is also essential to all anatomists because in it the principles of anatomy are very lucidly expounded.

So well are the principles described that the reviewer feels that here surely is a pattern on which anatomical textbooks should be written—in fact he would suggest that a textbook of general anatomy written by the present author in the same style would form the beginning of a new era in the teaching of anatomy, an era long overdue.

Besides explaining the general principles so well, especially in the first half of the book, topographical anatomy is not neglected and certain important structures seldom stressed in the textbooks are very well described, e.g., the intrinsic muscles and the nervous pathways and mechanisms: as also are the flexor lines, the cleavage lines and the fascias. The chapter on 'The action of muscles' is particularly worth study.

The bibliography is good and the reader is thereby given much scope for further study.

It may be said with confidence that this is a book which all medical students, and of course all anatomists, should read and it should also be studied by all those surgeons who operate on the hand.

G. C. T.

## Abstracts from Reports

### ANNUAL REPORT OF THE KING EDWARD VII SANATORIUM, BHOWALI, U. P., FOR THE YEAR 1941

The sanatorium remained open throughout the year and the accommodation available for the general public was fully occupied except during the winter months and, as usual, there was a waiting list during the season, especially for the cheaper classes. Enquiries and applications for admission were received not only from the various districts of the United Provinces but from other provinces also.

Forty-eight patients remained in the sanatorium on 1st January, 1941, from the previous year and 258 patients were admitted and 250 patients discharged during the year under report. The daily average number of patients treated was 112.94, the largest number being 167 during the month of May, and the lowest 43 in the month of January.

The results of treatment in 209 cases were as follows:—arrested—27.27 per cent; much improved—7.66 per cent; improved—19.14 per cent; stationary—24.40 per cent; worse—15.31 per cent; died—6.22 per cent.

The financial condition of the sanatorium remained satisfactory.

Water supply to the sanatorium being an urgent need, the public health engineer studied the problem

and submitted estimates costing about Rs. 13,500 for this purpose. The committee has accepted the estimates and has written to the public health engineer in order to find out if the work can be completed at the estimated cost on account of the abnormal conditions due to war.

The question of electric installation in the sanatorium has been kept in abeyance for the present as it would not be possible to get the necessary plant and material as long as the war lasts.

### THIRD ANNUAL REPORT OF THE TUBERCULOSIS ASSOCIATION OF INDIA FOR THE YEAR 1941

The continuation of the war and the grave international situation could not but have their repercussions on the progress of our work, but in spite of this, the association has been able not only to consolidate the work already started, but also to make considerable progress in new directions.

The most outstanding event of the year was the opening of the Lady Linlithgow Tuberculosis Sanatorium at Kasauli, which, while providing up-to-date treatment for tuberculous patients from all parts of India, will also act as a teaching centre for specialized training in tuberculosis.

There has been a further increase in the number of institutions in India for the diagnosis and treatment of tuberculous patients. Several post-graduate courses have been held for training doctors in tuberculosis work, and there have been courses for training tuberculosis health visitors, in several centres. Additional tuberculosis associations have been initiated or are in the process of formation.

The second annual general meeting of the association took place at the Viceroy's House, New Delhi, on the 25th March, 1941, and was presided over by Her Excellency the President of the association. In her presidential address, Her Excellency expressed gratification at the satisfactory record of progress of the association during the past year. She referred to the good work done by the New Delhi Tuberculosis Clinic, and to the Government of India's acceptance of the Kasauli scheme put before them by the association.

Dr. C. Frimodt-Møller continued as Medical Commissioner until 10th August, on which date he was unfortunately taken ill and placed on sick leave. Dr. P. V. Benjamin, Medical Superintendent of the Union Mission Tuberculosis Sanatorium, Arogyavaram, was appointed officiating Medical Commissioner.

Under the auspices of the Central Association, two short post-graduate courses in tuberculosis were organized in Bombay and Calcutta during the year 1941. No tuition or admission fee was charged. Certificates of attendance were granted at the termination of the courses.

At the request of the Tuberculosis Association of India, the publishers of the *Indian Medical Gazette* brought out their 1941 October issue as a special tuberculosis number, this being the fifth year in succession in which such a number has been published. These special tuberculosis numbers have not only been popular in this country but also have attracted considerable attention outside India. The committee wish to record their sense of indebtedness to the editor, Dr. L. E. Napier, as well as to the management of the *Gazette* for so willingly publishing the special tuberculosis number.

Two new tuberculosis associations were formed during the year and affiliated to the Tuberculosis Association of India. The total number of affiliated tuberculosis associations has now risen to 26.

The New Delhi Tuberculosis Clinic, which was opened by Her Excellency the Marchioness of Linlithgow on 20th November, 1940, has made steady and satisfactory progress. The clinic functions as a centre for the diagnosis of tuberculosis in doubtful cases where assistance is sought by private practitioners and other institutions. The number of new

patients who attended the clinic for this purpose was 1,694. Of these nearly 50 per cent were referred to the clinic by other institutions and doctors. Patients so referred to the clinic are returned to the respective doctors with proper diagnosis and advice, and they are treated at the clinic only at the express wishes of the doctors concerned. The total number of patients (including new and old) who attended the clinic since November 1940 was 20,375. Seventy-six patients were admitted to clinical beds for observation, their average stay being 24.4 days.

The health visitors employed at the clinic visit patients in their homes to give advice to them and their relatives, and to arrange for the attendance and examination of contacts at the clinic. Contacts examined at the clinic number 869, of whom about 10 per cent were found suffering from tuberculosis and placed under treatment.

A care and after-care committee for carrying out an experimental scheme of organized home treatment from the New Delhi Tuberculosis Clinic has been constituted under the chairmanship of Sir Shri Ram. A municipal area with a population of about 20,000 people has been chosen for this work, and four doctors practising in that area have been appointed to visit patients in their homes. Relief is provided for poor patients in the form of (a) milk to patients or under-nourished members of the family, (b) payment for transport and (c) provision of medicines and medical necessities. The expenses of this scheme are met from a grant of Rs. 4,000 from the Chief Commissioner, Delhi, and from collections by the committee members.

Reports of the work done during the year 1941 have been received from all affiliated bodies, and they are very encouraging.

## Service Notes

### APPOINTMENTS AND TRANSFERS

COLONEL H. E. SHORTT, C.I.E., V.H.S., is appointed Honorary Physician to the King, dated 23rd August, 1941, *vice* Major-General P. S. Mills, C.I.E., retired.

Colonel J. S. S. Martin, V.H.S., is appointed Honorary Surgeon to the King, dated 13th October, 1941, *vice* Colonel E. G. Kennedy, deceased.

The services of Colonel J. B. Hance, C.I.E., O.B.E., V.H.S., Inspector-General of Civil Hospitals, C. P. and Berar, and Director of Public Health, C. P. and Berar, in addition have been placed at the disposal of the Government of India for special duty and he made over charge in this province on the afternoon of 24th July, 1942.

Lieutenant-Colonel N. S. Jatar, C.I.E., D.S.O., I.M.S. (Retd.), Inspector-General of Prisons, C. P. and Berar, has been appointed as Inspector-General of Civil Hospitals, C. P. and Berar, in addition to his own duties with effect from the afternoon of 24th July, 1942.

Major W. Scott, on return from 1 month's leave, has been posted as Civil Surgeon and Superintendent, Robertson Medical School, where he assumed charge on the forenoon of 18th July, 1942.

Major S. P. Bhatia, Deputy Assistant Director-General (Medical Stores), Medical Store Depot, Calcutta, is appointed Additional Assistant Director-General, Indian Medical Service (Stores), *vice* Major H. B. Wright, with effect from the afternoon of the 10th August, 1942.

The services of Captain H. W. G. Staunton, an officiating Agency Surgeon, were placed at the disposal of His Excellency the Commander-in-Chief, with effect from the afternoon of the 9th January, 1942.

### INDIAN LAND FORCES

#### (Emergency Commissions)

#### To be Captains (on probation)

Shiva Chandra Banerjee. Dated 5th February, 1942.

Aswini Kumar Nandi. Dated 5th March, 1942.

Kailash Nath Tandi. Dated 7th March, 1942.

Ponathil Balakrishna Kurup. Dated 13th March, 1942.

6th April, 1942

Dattatraya Gangadhar Karandikar.

Kumud Behari Chowdhury.

To be Lieutenants (on probation)

Ram Swarup Verma. Dated 15th March, 1941.

Inder Singh. Dated 4th November, 1941.

5th December, 1941

Francis Ernest Bedoll.

Narayanaier Ananta Subramanyam.

4th February, 1942

Ampattu Thomas George.

Iqbal Chand.

Om Parakash Markandya.

Kartar Singh Jolly.

5th March, 1942

N. Subramanyan.

S. Sankaran.

Veriam Singh Bhattal.

Therkathaw Mathew.

Ayalasomayajula Narasimham.

Nirod Baran Banerjee.

Mahananda Ray.

Anilendra Nath Das Gupta.

Amulya Kumar Ray.

Ramesh Chandra Mitra.

Marai Govindan Kutty Menon.

Madho Lal Sudan.

Bhanushanker Revashanker Joshi.

Mahmud Ahmad.

Lal Rajendranath Shah-Deo.

Khurshed Nussarwanji Gubbar.

Manohar Nath Hukum.

Kannard Ramsey Unger.

Dara Manekji Goghavala.

Scrab Cooverji Driver.

Harry Chatterjee.

Framroze Naserwanji Kapadia.

Sahib Dyal Sikand.

Azhar Kidvai.

6th March, 1942

Hriday Bhusan Mallick.

Suresh Chandra Lahiri.

Maulana Mohammad Abdul Jabbar. Dated 7th March, 1942.

Thelapurath Madhavan Nair. Dated 12th March, 1942.

Amarendu Sekhar-Sen. Dated 15th March, 1942.

5th April, 1942

Ridsdale Charles Perriman Thomas.

James Walter Cazalet.

6th April, 1942

Kunneth Raman Madhavan.

Sudhir Kumar Nandy.

Bibhuti Bhushan Sarkar.

Kumbakonam Swaminath Srinivas.

Manindra Sankar.

Sarat Chandra Sen Gupta.

Prabhat Kanta Dhar.

Sibdas Ray.

Tarak Jiban Gupta.

Somnath Saha.

Shambhu Bhaskar Jathar.

Surendra Nath Das.

Anwarul Haq.

Balkrishna Govind Sarnabat.

Jehangir Kaikhashru Adranvala.

Jethalal Ramchand Shah.

Muhammad Habibullah.

Surendra Gururao Sidenur.

Haran Krishna Mallick.

Homi Ardeshir Press.

Byram Rustom Irani.

Laxman Keshav Kale.

Dinker Vishvanath Bapat.

Sadashiv Yeshvant Torne.

Jehangir Pestonji Chothia.

7th April, 1942

Jitendra Nath Das Gupta.  
Cyril Joseph Pinto.  
Naresh Chandra Datta.  
Vinayak Gopinathji Hate.  
Hari Das Mukerjee. Dated 8th April, 1942.

5th May, 1942

Bhabanath Das Gupta.  
Thirupati Krishnama Chary.  
Anil Krishna Mitra.  
Natwarlal Chamanlal Mehta.  
Nirmal Kumar Sen.  
Banwari Lal.  
Girindra Krishna Mitra.  
Radha Syam Saha.  
Maharaj Narain Razdan.  
Durga Charan Bhar.  
Alfred Wolfgang Lisboa.  
Surat Singh Grewal.  
Labhaya Milhotra Ram.  
Abdul Rashid.  
Hukam Chand Dhawan.  
Sitaramayya Gopaleswami.  
Nanda Kumar Acharyya.  
Mirza Rafique Beg.  
Shiv Dev Surie.  
Leonard Sebastian Zuzarte.  
Shamsher Bahadur Singh Bawa Bhalla.  
Bejoy Krishna Chawdhurim.  
Nrisingha Chandra Banerjee.  
Rabindra Kumar Mitra.  
Shivram Vishwanath Tilak.  
Krishnadhan Banerjee.  
Raj Kumar.  
Prafulla Kumar Mukerjee.  
Abdul Rashid.  
Rustam Dinshaw Irani.  
Arjan Das Papneja.  
Ganesh Pandurang Sathe.  
Keshav Hari Bhadbhade.  
Bhalchandra Vinayak Shirolkar.  
Hemanta Kumar Mitra.

6th May, 1942

Percival Joseph Fonceca.  
Kyppanattu Lukose George.  
Bhupendra Nath Chatterjee.  
Pallathucheril Varkki Kurian.  
Herculane DeSouza.  
Bijay Gopal Sur.  
Nibaran Chandra Ghosh.  
Amulya Gopal Chaudhuri.  
Sailendra Kumar Bose.  
Sorab Shapurji Nazir.  
Haqiqat Rai Ohrie.  
Hit Abhilashi Bali. Dated 16th July, 1942.

## INDIAN LAND FORCES

## (Emergency Commissions)

*To be Captain (on probation)*

Rajeswar Bhattacharya. Dated 29th June, 1942.

*To be Lieutenants*

8th April, 1942

William John Aitken.  
Arthur James McGibbon Cathro.  
Christopher Hugh Marry.  
Walter Eugene Owens.  
George Quayle.  
Thomas Stephens.  
A. M. Merriweather.  
W. M. Doolin.  
J. D. Phibbs.  
B. M. Medley. Dated 11th April, 1942.  
Mary Antonia Columba MacHugh. Dated 18th June, 1942.

*To be Lieutenants (on probation)*

5th June, 1942

Hatimbhai Shaikh Abdulally Malik.  
Prakash Chandra Basu.

Abdul Karim.  
Sundararaj Lite.  
Sundaram Iyer Ram Chandra Sharma.  
Kaveripakam Umapathi.  
Ramier Rajagopalan.  
J. Srinivasan.  
Salem Rangiah Naidu Aravinda Babu.  
Akshoy Kumar Ray.  
Heramba Chandra Banik.  
Satyendra Nath Seal.  
Brajamadhav De.  
Mrinal Kanti Ray.  
Baldev Singh Khangura.  
Janardan Kashinath Gharpure.  
Dunia Lal De.  
Sati Bhusan Mitra.  
Aloke Chandra Bose.  
Syed Baqir Husain Gardezi.  
Tiruchendurai Muthukrishnan Seethapathy.  
Ram Nath Chopra.  
Syed Abid Ali.  
Hoskote Panduranga Rao.  
Harbans Singh Jawanda.  
Jagjit Singh.  
Mohammad Icbal.  
Nirmal Krishna Basu.  
Bhabani Prosad Das Gupta.  
Nanda Gopal Mukerjee.  
Syed Nasiruddin Ahmad.  
Kodandara Chenppah Ganapathy.  
William Mervyn Sydney Jones.  
Nallepilly Renganatha Ramakrishnan.  
Edgar Joseph D'Netto.  
Venkata Pathi Rangaswami.  
Victor Selvaraj.  
Surajit Kumar Bandopadhyay.  
Bijoy Kumar Banerjee.  
Dahatraya Laxmanrao Bhagwat.  
Mukundlal Banerjee.  
Prabhakar Bhavani Koppiker.  
Srinivasan Krishnan.  
Rayasam Ramachandra Rao.  
Alex Mascaranhas.

6th June, 1942

Arani Parthasarathy Babu.  
Mohammed Rahimulla.  
Abdul Majid Khan.  
Burjore Edulji Pardiwalla.

7th June, 1942

Ananthram Shetty.  
Edward Paul Gonsalves.

8th June, 1942

Saidapet Pachai Vedachalam.  
Manjeshwar Gopalkrishna Prabhu.  
Duraishwamy Aiyar Narasimhan.  
Giddu Venkataramniah. Dated 9th June, 1942.  
Natesa Narayanan. Dated 10th June, 1942.  
Edmund Thomas Garthwaite. Dated 22nd June, 1942.  
Cirusari Rangachari Krishnaswami. Dated 9th July, 1942.  
Christian Gerald Muller. Dated 5th May, 1942.  
Cecil Howard Phillips. Dated 3rd July, 1942.  
Leopold William Ashton Rose. Dated 10th July, 1941.  
*To be Lieutenant (on probation) for service in the Indian Air Force*

Mohammed Umar Hayat. Dated 15th March, 1942.

*To be Lieutenants (on probation)*  
(Relative rank)

Miss Phiroza Santook Daver. Dated 8th April, 1942.  
Miss Lajjavati Bhargava. Dated 11th April, 1942.  
Miss Doreen Mary Josephine Stracey. Dated 17th April, 1942.  
Mrs. Svarna Lata Bhatia. Dated 2nd May, 1942.  
Miss Freney Pestonji Wadia. Dated 4th May, 1942.  
Miss Merle Winifred Beeby. Dated 31st May, 1942.  
Miss Rose Helen Fonseca. Dated 19th May, 1942.  
Mrs. Manijh Rustam Tarapore.

## PROMOTIONS

*Captains to be Majors*

A. E. Kingston. Dated 1st August, 1939.  
G. B. Thomas. Dated 1st August, 1941.  
G. F. Harris. Dated 3rd August, 1942.

5th August, 1942

J. Edis Myers. R. De Soldenhoff.  
L. Feinhols. Dated 1st August, 1942.  
E. Parry. Dated 15th August, 1942.

## INDIAN LAND FORCES

*(Emergency Commissions)**Lieutenants to be Captains*

S. A. Wadud. Dated 15th July, 1941.  
21st November, 1941

V. N. Khanna. Mohd Ayub Khan.  
F. J. Bilimoria. R. Singh Rao.

*Lieutenants (on probation) to be Captains (on probation)*

Satya Pal. Dated 8th December, 1941.  
Perampally Sitarama Rau. Dated 10th January, 1942.  
21st November, 1941

|                   |                     |
|-------------------|---------------------|
| C. M. Burnie.     | R. H. Neeve.        |
| J. R. Davidson.   | H. C. Duncan.       |
| A. L. Sutherland. | H. W. T. Martin.    |
| H. B. T. Holland. | E. T. Harrington.   |
| W. Donkin.        | G. D. Lehmann.      |
| W. G. Anderson.   | E. Dunsby.          |
| R. A. Johnson.    | Hugh Flack.         |
| A. E. Stevens.    | J. H. Arthur.       |
| J. D. Hardy.      | A. B. Gilroy.       |
| E. L. Lloyd.      | B. A. Lamprell.     |
| F. Lake.          | O. J. S. Macdonald. |
| A. D. Iliff.      | C. F. S. Alken.     |
| L. J. Michael.    | T. B. M. Sloan.     |

R. M. Vanreenan.

*Lieutenants to be Captains (on probation)*

G. Henderson. Dated 5th December, 1941.  
J. O. Gordon. Dated 30th December, 1941.  
S. F. Thomas. Dated 5th January, 1942.

*Lieutenants (on probation) to be Captains (on probation)*

21st November, 1941

A. D. Wilson. M. B. Klein.  
P. A. L. Roberts.

10th January, 1942

S. L. Jones. D. G. Horan.  
P. S. Clarke. R. T. Hinde.  
T. D. Brown. W. Thomson.

P. N. Swift.

30th January, 1942

W. N. O. George. D. S. M. E. Mooney.

5th March, 1942

|                  |                    |
|------------------|--------------------|
| K. J. L. Scott.  | J. E. M. Melville. |
| A. D. Dyson.     | F. A. Whitlock.    |
| W. M. Jones.     | G. E. Spear.       |
| D. C. Logan.     | D. A. Maclean.     |
| G. V. Faulkner.  | A. F. J. M. Thom.  |
| H. R. S. Harley. | P. Jacobs.         |
| A. C. Mackenzie. | A. J. Sinclair.    |
| J. B. David.     | D. Macaulay.       |
| N. J. MacQueen.  | E. D. Macworth.    |

9th April, 1942

O. Clarke. A. Maples.  
R. M. Gilchrist. M. A. Fawkes.  
E. J. Currant. J. T. Millar.  
J. Cameron. N. W. Gill.  
J. Mockler. P. H. Blackiston.

INDIAN MEDICAL SERVICE  
(DENTAL BRANCH)*(Emergency Commissions)**Lieutenants to be Captains*

5th June, 1942

R. N. Dogra. W. Singh.  
I. M. Manchanda. R. B. D. Sagreiya.

5th July, 1942

S. F. Ilahi. V. S. Sehgal.  
R. Pratab. J. R. D. Ahuja.  
M. Raj. M. Shafique.

W. J. Sequeira. Dated 6th July, 1942.

The undermentioned Lieutenant (on probation) is confirmed in his rank, with effect from the date specified:—

S. A. Wadud. Dated 15th July, 1940.

## Notes

## EYELEX

MESSRS. UNION DRUG COMPANY, LIMITED, Calcutta, announce the introduction of their sulphonamide ointment, Eyelex, in an improved packing. The current collapsible tube will be replaced by wide-mouthed glass container with a cork top. To facilitate application, a blunt-headed glass insertion rod will also be added with each packing. In spite of the increased cost, the rate and quantity of the ointment will remain as before.

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The Editors of *The Indian Medical Gazette* cannot advise correspondents with regard to prescriptions, diagnosis, etc., nor can they recommend individual practitioners by name, as any such action would constitute a breach of professional etiquette.

## Original Articles

### NOTE ON ECONOMY IN THE USE OF ANTI-MALARIAL DRUGS

By G. COVELL, M.D., D.P.H., D.T.M. & H.  
COLONEL, I.M.S.

*Director, Malaria Institute of India*

Now that the source from which the bulk of the cinchona alkaloids consumed in India in pre-war years was derived is no longer available, every possible avenue which may help to overcome the emergency thus created must be explored.

One obvious step is the extension of cinchona cultivation in India so that the country may ultimately become self-supporting in this respect, but several years must elapse before the new plantations can produce a sufficient quantity of the bark to meet all requirements. Another is to manufacture synthetic anti-malarial drugs on a scale large enough to bridge the gap which must exist until the output of cinchona alkaloids has been fully developed; but here again there must be a considerable time-lag before adequate supplies of such drugs can be made available in India.

It is therefore necessary to scrutinize anew our methods of combating malaria, both by therapeutic and preventive measures, and to explore the possibilities of effecting an immediate reduction in the consumption of anti-malarial drugs, either by modifying our schemes of treatment, or by intensifying our efforts to reduce the incidence of the disease and the scope and severity of regional epidemics. The object of this note is to draw attention to certain aspects of each of these lines of approach to the problem.

#### I. Dosage and duration of treatment

Perhaps the most remarkable feature of malaria as a disease is its tendency to relapse. Whatever treatment may be adopted, a certain proportion of patients continue to suffer from periodical attacks of fever, sometimes for several years. It was this consideration which led in the past to the administration of quinine and other preparations of cinchona in large doses and to the adoption of prolonged courses of treatment, frequently extending over several months.

In recent years it has come to be recognized that there is no advantage either in prescribing massive doses of anti-malarial drugs or in administering such drugs over prolonged periods. The tendency of malaria cases to relapse is to a large extent independent of the dosage given and of the duration of treatment. Short courses of treatment, frequently of only a week or even less in length, have therefore become the rule,

and the daily dosage has also been reduced. The introduction of malaria therapy for the treatment of general paralytics has provided an unrivalled opportunity for research on this subject, and it is largely on the experience thus gained that modern ideas regarding the treatment of malaria are based.

A lengthy series of carefully controlled experiments, conducted in a number of different countries under the auspices of the League of Nations, has confirmed the view that the administration of anti-malarial drugs over long periods when the infection is latent is not merely useless, but may retard the development of the defensive mechanism of the patient, without which the parasite cannot be eradicated from the body. The results of these experiments were published in the *Fourth General Report of the Malaria Commission of the League of Nations* (1937), on which most of the schemes of treatment now in practice throughout the world are based. A chart embodying the findings of the Commission in respect of the action of quinine and the various synthetic anti-malarial drugs, together with its suggestions as to treatment, was published by the Malaria Institute of India in the same year (see table).

There are certain difficulties in framing a standard scheme of treatment appropriate for all circumstances. Not only do the different species of malaria parasite vary in their reaction to treatment and tendency to relapse, but the different local strains of each parasite show wide variations in this respect. An extreme instance is that of an Italian strain of *Plasmodium falciparum*, which was found to require eight times as much quinine to control primary infections as a strain of the same species of parasite originating from India. A further complication is the great variation of individual patients in their reaction to malarial infection and thus to the effect of a particular course of treatment. It follows from these considerations that a line of treatment which would be effective for one strain of a malaria parasite may be insufficient for another. Similarly, a course which would cure an infection in one patient may be ineffective for another, even though the species and strain of parasite are identical.

For these reasons, the scheme of treatment for individual patients put forward by the League of Nations Malaria Commission was framed with considerable elasticity. The routine treatment suggested prescribed quinine 15 to 20 grains, or atebirin 0.3 gramme, for 5 to 7 days, i.e. a minimum total dosage of 75 grains quinine, or 1.5 grammes atebirin, and a maximum of 140 grains quinine or 2.1 grammes atebirin; followed in each case by 0.02 gramme plasmoquine daily for 5 days.

Much of the misapprehension and divergence of view regarding the treatment of malaria has been due to lack of precise knowledge as to the action of the various drugs employed. No drug



TABLE  
Action of quinine and the synthetic drugs on malaria  
(Based on 4th General Report of League of Nations Malaria Commission)

|            | ACTION ON TROPHOZOITES   |  | ACTION ON GAMETOCYTES                        |   | ACTION ON ACUTE SYMPTOMS   |  | Action on frequency of relapse  | Action on splenomegaly   | Effect on general condition of patient                                       |
|------------|--|--|--|---|--|--|---|--|--|
|            | B. T. + Q.   | M. T.  | B. T. + Q.                                   | M. T.   | B. T. + Q.   | M. T.  |   |  |  |
| Quinine    | Daily dose of 1 gm. (15 grs.) causes disappearance, 5-7 days.                              | Daily dose of 1.3 gm. (20 grs.) causes disappearance, 5-7 days.                  | Affects pre-gametocytes and gametocytes.     | Affects pre-gametocytes but gametocytes only very slightly. | Marked action from 3rd day (2nd paroxysm).                               | Variable action from 3rd or 4th paroxysm.  | Acts on all species but in B. T. and Q. relapse rate may reach 50 per cent.   | Acts on all species but effect is transient where re-infection or relapses are frequent. | No effect if treatment is limited to number of days essential.               |
| Atebrin    | Daily dose of 0.3 gm. causes disappearance after 3 days. Effects last longer than quinine. | Daily dose of 0.3 gm. causes disappearance after 4 days in 90 per cent of cases. | Similar to quinine but slightly more marked. | Similar to quinine.   | Very marked action. Fever falls by 2nd paroxysm.                         | Marked action. Fever usually falls by 3rd paroxysm (but with some strains effect is less than with quinine). | Action slightly more than quinine especially in B. T. and certain strains of M. T.  | Effect somewhat slower than quinine but seems to last longer.                            | Sometimes yellow coloration of skin.   |
| Plasmochin | Slight action only.  | Practically no action.   | Definite action in both species.             | Marked action in minimum doses of 0.02 gm.                  | No indications for using plasmochin alone for treatment of acute attack. |  | Definite effect in B. T. and Q. In association with quinine and atebrin it has a marked effect in reducing relapses in all three species. | Insufficient data.   | In the doses now used (e.g., 0.2 gm.) it seems to have no depressing effect. |

### NOTES

#### A.—ACTION OF COMBINATIONS OF DRUGS

1. There is no advantage in combining quinine and atebrin in treatment.
2. Quinine + plasmochin simultaneously produce less frequent and less intense toxic symptoms than atebrin + plasmochin, but are best given consecutively where possible. Quinine (15-20 grains daily, 7 days) + plasmochin (0.02 gm. daily, 5 days) are probably the best treatment for B. T. and Q. malaria.
3. Simultaneous administration of atebrin and plasmochin aggravates the toxicity of each and is not recommended. Consecutive treatment with atebrin (0.30 gm. daily, 5-7 days) and plasmochin (0.02 gm. daily, 5 days) has no advantage in the primary attack, but acts on gametocytes and relapses in the same manner as quinine and plasmochin treatment.

#### B.—PRACTICAL SUGGESTIONS FOR TREATMENT

1. *Individual treatment.*—Quinine (15-20 grains) or atebrin (0.3 gm.) 5-7 days, followed by plasmochin (0.02 gm.) 5 days, or quinine + plasmochin simultaneously.
2. *Treatment in field.*—Quinine (15-20 grains) or atebrin (0.3 gm.) 5-7 days, followed by plasmochin (0.02 gm.) 5 days if funds and medical supervision are available. But if, as is usual, this is not so, short treatments with the cinchona alkaloids are more suitable.
3. *Mass drug prophylaxis.*—Daily doses of quinine (0.40 gm. or 6 grains), or twice weekly doses of atebrin (0.20 gm.).

at present known destroys the sporozoites injected by the mosquito, and therefore no drug prevents malarial infection. The chief functions of both the cinchona alkaloids and atabrin are to cut short the clinical attack and to destroy the malaria parasite in the trophozoite stage. They are useless during the incubation period or when the disease is latent, and no intensification of dosage or prolongation of treatment will effect the radical cure of more than a certain percentage of infections. Plasmochin has no effect on the clinical attack, its great value in treatment being to reduce the percentage of relapses.

The realization of these principles has led to a certain modification of the aims of treatment. The physician no longer strives to eradicate the disease in all cases by the administration of large doses of drugs over a prolonged period. His object is rather to tide the patient over his attack by giving him just that amount of medication which will enable the defensive mechanism of his body to exert its maximum effect. This is brought about by the administration of a short course of quinine or atabrin (5 to 7 days) followed by a similarly short course of plasmochin to reduce the risk of relapse. Some workers have recommended even briefer courses than this, the shortest of all being of Collins (1934), who introduced in Bulgaria a 4-day treatment consisting of 15 grains quinine daily for 3 to 4 days only. This proved effective for the treatment of the southern European strains of benign tertian malaria, but was not quite sufficient for patients infected with malignant tertian strains occurring in that region.

Under the present circumstances, when stocks of anti-malarial drugs are strictly limited, greater care than ever should be taken not to prescribe larger quantities than are absolutely essential. The basic objects of treatment should be the prevention of mortality and the maintenance of malarious populations in a condition which will enable them to carry out their daily work. As a general guide, it is suggested that routine treatment should be limited to 15 grains quinine or cinchona febrifuge, or 0.3 gramme atabrin, daily for not more than 5 days, provided that clinical symptoms have by that time subsided. This may be followed by 0.02 gramme plasmochin daily for 5 days if available. Needless to say, in putting forward these suggestions there is no intention of imposing any restriction on the treatment of cases of special urgency, such as cerebral malaria with delirium and coma, hyperpyrexia, or pernicious malaria with persistent vomiting. Such cases should receive quinine bihydrobromide or bihydrochloride by the intravenous route without a moment's delay, but with the usual precautions regarding speed of administration, to be followed by the routine oral treatment as soon as the urgent symptoms have abated.

## II. Preventive measures

Hitherto we have considered only methods of restricting the consumption of anti-malarial

drugs by modifications in dosage and duration of treatment. A far greater economy in this respect would be possible if we could by any means prevent the occurrence of widespread epidemics of malaria, or at least materially reduce their scope and severity.

The public-health aspect of malaria control has been treated in a separate paper (Covell, 1942). In this the conviction was expressed that the spray-killing of adult mosquitoes with pyrethrum insecticides would ultimately prove an effective weapon for combating rural malaria in India. The principle on which this method is based is that a mosquito can only transmit malaria if it has succeeded in living for not less than 10 days after having fed on a person with malaria parasites in his blood, and that if it can be destroyed within this period, it cannot convey the disease. There is no doubt that the general adoption of the spray-killing of adult mosquitoes in rural areas would effect a substantial reduction in India's annual requirements for anti-malarial drugs.

At present, the production of pyrethrum in India like that of cinchona is insufficient for the country's needs. But, unlike the case of cinchona, the development of pyrethrum cultivation in India is comparatively easy, and the required quantity can be produced far more rapidly. It has been demonstrated that pyrethrum of high quality can be grown without difficulty in many parts of India, but hitherto the area cultivated has been inconsiderable, except in Kashmir State.

It is the considered opinion of the writer that the extension of pyrethrum cultivation in India is of even more importance for the future of malaria prevention than that of cinchona. The chief obstacles to its production on a large scale are uncertainty as to the market price of present and future crops, and difficulty in obtaining land in areas suitable for its cultivation. The extension of pyrethrum cultivation in India should be encouraged by local governments in every possible way, and it is particularly important that no difficulties should be placed in the way of either private individuals or industrial concerns in obtaining suitable land from government sources.

## Summary

1. Since supplies of anti-malarial drugs are at the present time strictly limited, rigid economy in the consumption of such drugs is essential.
2. Suggestions are put forward for the modification of existing schemes of treatment with this object in view.
3. A further economy in the consumption of anti-malarial drugs could be effected by the

(Concluded on next page)

## CIRCULATION IN FIBRO-SARCOMAS

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WHEN a growth of large size occurs without commensurate blood supply, it is well known that degeneration takes place in it. In order to study the circulation in tumours, amputated limbs were used. Two cases of fibro-sarcoma in the forearm afforded the opportunity. The following procedure was adopted:—

After amputation of the limb, the brachial vein was ligatured and into the brachial artery which was held by forceps, an intravenous cannula was introduced and fixed by a ligature. A 20 c.cm. syringe containing lipiodol diluted with equal parts of liquid paraffin was fixed into the cannula and the fluid was injected slowly. The pictures show the circulation in two cases of fibro-sarcoma, and indicate the distribution of small capillaries in the growth. In the areas where the tumour is very thick, the capillaries are absent and this fact probably accounts for early degeneration clinically indicated by softening.

A study of circulation in the living is now made possible by injecting salts of thorium which causes no discomfort or untoward effects. It has not been done so far because of the difficulty of obtaining this salt in India. It should be made available to all clinical institutions wishing to study vascular disease.

These cases are reported to show the circulation in fibro-sarcomas. In one case of bone sarcoma in which this was attempted, the result was unsatisfactory, probably because of the lack of sufficient pressure to drive the fluid into the capillaries of the bone tumour. Further attempts will be made to study in future cases.

My thanks are due to Mr. R. Mahadevan, F.R.C.S., who helped me to carry out this experiment and to the radiologist Dr. P. Kesavaswamy for the roentgenograms.

(Continued from previous page)

general adoption of the method of spray-killing adult mosquitoes in rural areas throughout India as a preventive measure. To render this possible the extension of pyrethrum cultivation in India is essential, and should receive active encouragement from provincial governments.

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## PARTIAL DEGENERATION OF THE OPTIC NERVE ASSOCIATED WITH VITAMIN DEFICIENCY

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THE main features of the clinical condition which will be considered in this communication are as follows:—

The patient, usually a young adult, complains of slow and progressive loss of vision. No abnormalities which can satisfactorily account for the failure of vision are found in the media of the eye, but ophthalmoscopic examination reveals pallor of the temporal half of the optic discs. The condition is a common one; some 300 to 400 cases are seen annually in the Government Ophthalmic Hospital, Madras. Up to the present the aetiology of the disease has not been investigated in India and no effective method of treatment has been evolved. It has, however, been suspected that vitamin deficiency plays some part in causation.

## Investigation

A preliminary study of a series of cases of 'temporal pallor' was undertaken in the Government Ophthalmic Hospital, Madras. Forty-eight cases were examined. The age and sex distribution was as follows:—

| Age    | 0-10 | 10-20 | 20-30 | 30-45 |
|--------|------|-------|-------|-------|
| Male   | 1    | 16    | 10    | 1     |
| Female | 1    | 13    | 5     | 1     |

The majority were young men and women ranging in age from 15 to 30. All belonged to the poorest classes, with incomes per family ranging from Rs. 10 to Rs. 30 per month.

*Ophthalmic examination.*—The patients complained of dimness of vision, which had progressively increased over a period of months or years. According to histories given, the duration ranged from 10 months to 7 years. Many patients had visited several hospitals in search of relief. Near vision was fairly satisfactory, except in two patients older than the rest. No history of a sudden onset, associated with acute ophthalmic disease, could be elicited in any of the patients.

Vision in the various cases ranged from 6/12 to 3/60—i.e. from relatively slight impairment to gross defect. In most cases both eyes were equally affected.

The conjunctivæ were usually 'dirty' and pigmented. Xerosis and Bitot's spots were present in some cases. No gross changes could be seen in the cornea, but careful examination under the corneal microscope revealed very small white spots on the surface; these were seen to be distributed in greater numbers at the centre than at the periphery. The appearance given was as



Fig. 1.—Fibro-sarcoma of the forearm.



Fig. 4.—A fibro-sarcoma of a forearm.

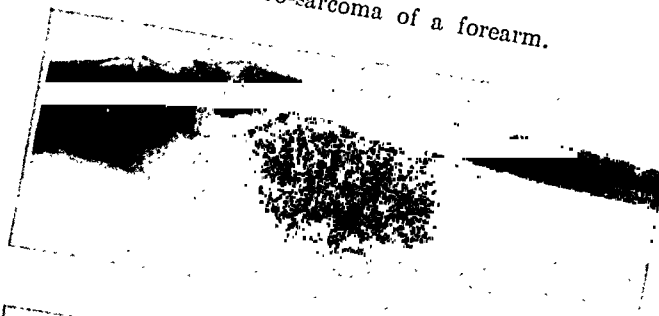


Fig. 5.—Radiograms antero-posterior and lateral showing that the tumour is unconnected with the bone.

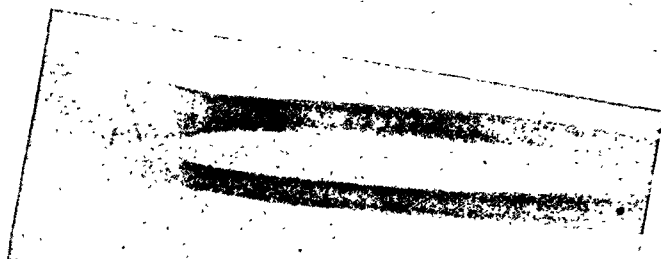


Fig. 6.

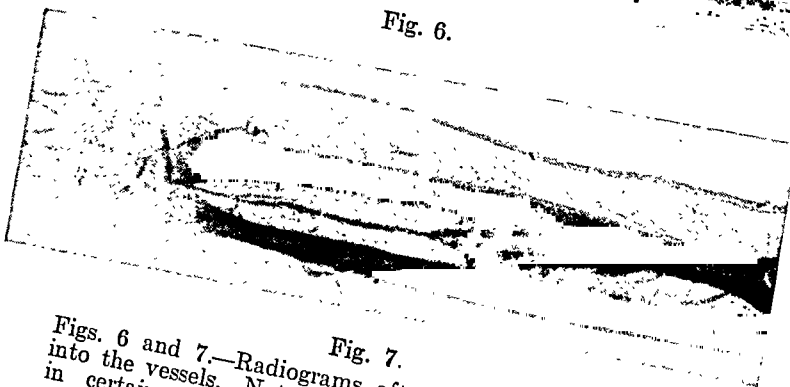


Fig. 7.

Figs. 6 and 7.—Radiograms after injection of lipiodol into the vessels. Note the capillaries and their absence in certain areas, and the dilatation of the vessel probably the main branch of the brachial artery supplying the tumour.



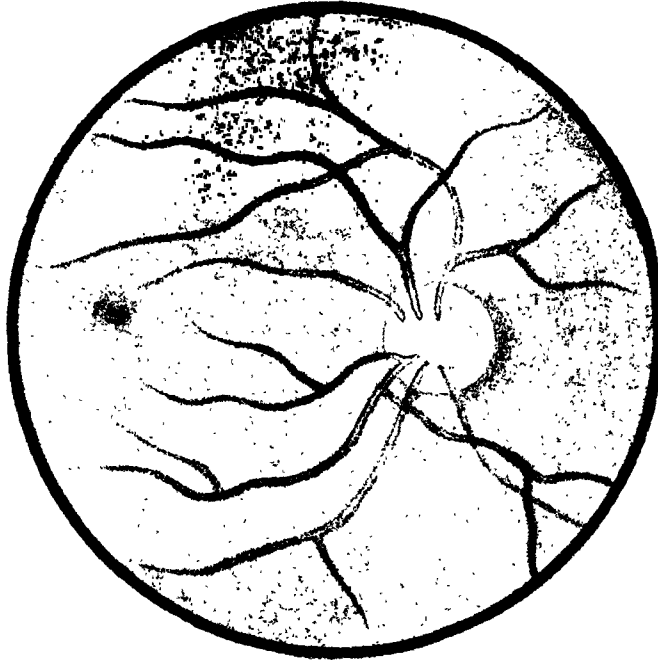
Fig. 2.—Radiogram of the tumour. Note that the bones of the arm appear normal.



Fig. 3.—Radiogram showing the lipiodol in the vessels. Note the distribution of capillaries and their absence in certain areas.

PLATE XXXI

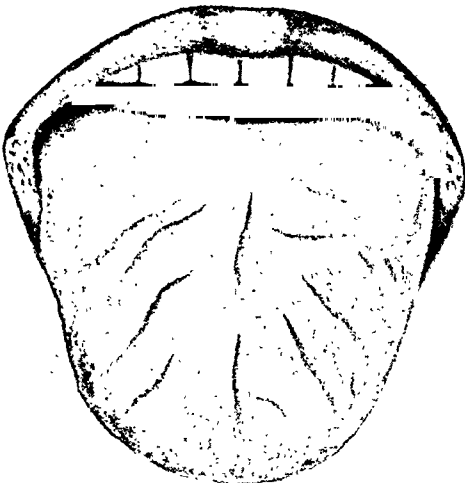
PARTIAL DEGENERATION OF THE OPTIC NERVE ASSOCIATED WITH VITAMIN DEFICIENCY : O. P. VERMA



Appearance of the optic disc in a typical case of 'temporal pallor'.

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RIBOFLAVIN AND ITS RÔLE IN NUTRITION : M. SWAMINATHAN



Fissured tongue in case of riboflavin deficiency.



Superficial keratitis due to riboflavin deficiency showing corneal opacities and circum-corneal injection.

[These two figures were sent for Dr. O. P. Verma's paper on 'Further Experience of the Treatment of Superficial Keratitis with Riboflavin' in our August number: they were however too late for inclusion and with his permission they are now being used to illustrate Dr. M. Swaminathan's paper 'Riboflavin and Its Rôle in Nutrition'.—EDITOR, I. M. G.]

if something had been sprinkled on the cornea. The stippling was apparently due to superficial epithelial degeneration and desquamation. The sclera, iris, and lens were normal.

The fundus was normal except for the optic disc. The latter in all cases showed pallor of the temporal half, the intensity of which varied from case to case, being extremely marked in some instances. The degree of pallor did not regularly correspond to the degree of dimness of vision. The nasal half of the disc remained pink and the disc margins were regular. The vessels were not markedly diminished in size.

The retinoscopic error was small in almost all cases (e.g. +0.5, +1.0, -0.5 spherical, or a small cylinder). Except in a few cases the rectification of the refractive error failed to bring about any improvement in sight. The field of vision was not affected. The diminution of the field on the nasal side was negligible and no central scotomata could be found.

Kahn and Wassermann tests were carried out on all patients and gave negative results. General examination revealed no evidence of disseminated sclerosis or other lesions of the nervous system. The teeth were fairly good and the throat in general normal. There was no history of acute infection, or of excessive indulgence in alcohol or tobacco. The possibility of the latter can be excluded on account of the poverty of the patients. It is to be observed that tobacco and alcohol amblyopia, in which pallor of the temporal side of the disc is often present, usually occurs in middle-aged or elderly men, whereas the patients included in this investigation were for the most part young men and women.

*Co-existence of deficiency diseases.*—The patients were in general in a poor state of nutrition and many showed evidence of food deficiency disease. In 18 xerosis conjunctivae was present and in 5 phrynoderma. The calves were tender and the knee jerks sluggish in 6 patients; this may be regarded as evidence of vitamin-B<sub>1</sub> deficiency. Nearly half showed angular stomatitis and fissured tongue of the type associated with riboflavin deficiency (Aykroyd and Verma, 1942). It seems likely that the superficial stippling described above was also evidence of the same deficiency. Superficial keratitis due to lack of riboflavin has recently been observed in out-patients in the same hospital (Aykroyd and Verma, *loc. cit.*) and the small superficial spots, visible only under the corneal microscope, may represent a very early and mild degree of this condition.

The incidence of deficiency diseases in the group is shown below, superficial stippling of the cornea being included in the list. If the latter is accepted as evidence of riboflavin deficiency, 85.6 per cent of patients showed co-existent deficiency disease. No doubt the examination of any random group of patients attending the ophthalmic hospital would reveal instances of deficient disease, but it is unlikely

that the incidence would be as high as in the group showing 'temporal pallor'. The presence of deficiency diseases in the majority of the group strongly suggests that the eye disease in question is due to malnutrition.

|  |    |    |
|--|----|----|
| Total number of cases  | .. | 48 |
| <i>Number showing :</i>  |    |    |
| Xerosis  | .. | 18 |
| Phrynoderma  | .. | 5  |
| Angular stomatitis and fissured tongue                                   | .. | 23 |
| Red raw tongue   | .. | 1  |
| Tender calves and sluggish knee jerks                                    | .. | 6  |
| Small superficial spots on the cornea revealed by the corneal microscope | .. | 38 |
| No signs of coincident deficient disease                                 | .. | 6  |

### Treatment

No method of treatment can be expected to produce an immediate and dramatic improvement in a condition characterized by degeneration of nervous tissue. The administration of certain vitamins appeared, however, to have a beneficial effect if continued for 3 to 6 months. Trial of this method of treatment was suggested by the high incidence, among patients suffering from 'temporal pallor', of conditions due to vitamin deficiency.

Treatment consisted of the administration of dried yeast and shark-liver oil. In many cases yeast was given alone, in doses of 7 g. daily, for a period of about one month. This had a good effect on the oral signs of vitamin-B<sub>2</sub> deficiency and often appeared to clear the vision without increasing its range, possibly because of the action of the riboflavin which it contains on the superficial epithelium of the cornea. Shark-liver oil, given in doses supplying 60,000 to 80,000 I.U. of vitamin A daily, appeared to produce genuine improvement in vision in a number of cases. The oil used had a value of 10 to 12,000 international units per gramme. Injections of vitamin B<sub>1</sub>, given without other forms of treatment, did not lead to improvement.

The effect of treatment by yeast and shark-liver oil on 13 cases is recorded in the table. These cases were the only ones which remained consistently under treatment for one month or more. Improvement was most satisfactory in cases in which the original degree of dimness of vision was less severe. In some of these cases vision returned to normal. In more severe cases the degree of improvement was in general less, presumably because in such cases nervous degeneration was more advanced and dead nerve fibres cannot be restored to function. The pallor of the disc diminished in most cases with improvement in vision, but changes in the appearance of the disc and in vision were by no means parallel. In some cases which showed very marked improvement in vision some temporal pallor remained after a full course of treatment with shark-liver oil.

The appearance of the disc in a typical case is shown in the accompanying coloured drawing.



TABLE

Description of patients showing impairment of vision with pallor of the temporal half of the optic disc

| Number | Age and sex | Vision                             | Duration, years | Signs of deficiency disease   | Fundus examination  | Treatment  | Duration of treatment in months | Results  |
|--------|-------------|------------------------------------|-----------------|---|---|--|---------------------------------|--|
| 1      | 16, M.      | R. 6/24<br>L. 6/18<br>J., E. E.    | 6               | General weakness.<br>Angular stomatitis.                                      | Temporal pallor of both optic discs.                                    | SLO 3i, b.d.   | 3½                              | R. 6/6 P.<br>L. 6/9.<br>J., E. E.  |
| 2      | 20, F.      | R. 6/12<br>L. 6/12<br>J., E. E.    | 1               | Angular stomatitis.<br>Fissured tongue.<br>Photophobia both eyes.             | Do.   | Yeast 3i, t.d.s.<br><br>SLO 3i, b.d.<br>(no yeast).                          | 1<br><br>1½                     | No photophobia and burning in eyes.<br>No angular stomatitis.<br>No improvement in vision.<br>R. 6/6. L. 6/6.  |
| 3      | 35, M.      | R. 6/18<br>L. 6/18<br>J., E. E.    | 2               | Tender calves.<br>Burning in feet.<br>Angular stomatitis and fissured tongue. | Do.   | Vitamin B <sub>1</sub><br>5 mg. i.m.i.<br>Yeast 3i, b.d.<br><br>SLO 3i, b.d. | ¾<br>1¾<br>2                    | Improvement in condition of calves and feet.<br>Vision unchanged. Mouth and tongue cured.<br>R. 6/6. L. 6/6. J., E. E.<br>Angular stomatitis recurred.<br>Glasses for near vision given. |
| 4      | 22, M.      | R. 6/24<br>L. 6/18<br>J., E. E.    | 3               | Angular stomatitis and fissured tongue.                                       | Do.<br>Solar injury L. E.   | Yeast 3i, b.d.<br>SLO 3i, b.d.   | 1<br>3¾                         | Angular stomatitis healed.<br>Vision unchanged.<br>R. 6/9.<br>L. 6/12.   |
| 5      | 13, M.      | R. 6/18<br>L. 6/12<br>J., E. E.    | 6/12            | Angular stomatitis.<br>Scaly and rough scrotum.<br>Xerosis each eye.          | Temporal pallor of both optic discs.                                    | Riboflavin<br>5 mg. orally.<br><br>SLO 3i, b.d.                              | ¾<br>2¾                         | Angular stomatitis healed.<br>Scrotum healed.<br>No improvement in vision.<br>R. 6/6. L. 6/6. Slight angular stomatitis.<br>Burning in mouth.<br>Itching in scrotum started again.       |
| 6      | 22, M.      | R. 6/18 P.<br>L. 6/24<br>J., E. E. | 1½              | Xerosis each eye.<br>Angular stomatitis.                                      | Do.   | SLO 3i, b.d.<br><br>Yeast 3i, b.d.   | 2¾<br>2¾                        | R. 6/12. L. 6/12. Angles of mouth same.<br>R. 6/9 P. L. 6/9 P.<br>Angular stomatitis healed.   |
| 7      | 20, M.      | R. 6/60<br>L. 6/36                 | 5               | Bitot's spots E. E.<br>Angular stomatitis and fissured tongue.                | Myopic fundus.<br>Temporal pallor of both discs.<br>Thinning of retina. | Yeast 3i, b.d.<br><br>SLO 3i, b.d.   | 2½<br>3                         | Angular stomatitis healed.<br>Tongue normal. No change in vision.<br>R. 6/12 P. L. 6/18. With glasses vision became 6/12 B. E.   |
| 8      | 14, M.      | R. 6/60<br>L. 6/60                 | 7               | Xerosis   | Temporal pallor of both discs.<br>A few patches of chorioiditis.        | Yeast 3i, b.d.<br><br>SLO 3i, b.d.   | 3<br>2½                         | R. 6/36.<br>L. 6/36.<br>No further improvement in vision.  |
| 9      | 19, F.      | R. 6/36<br>L. 6/60                 | 6               | Nil   | Myopic fundus.<br>Temporal pallor of both discs.                        | SLO 3i, b.d.   | 1½                              | R. 6/9. With glasses.<br>L. 6/9.   |
| 10     | 16, M.      | R. 5/60<br>L. 5/60                 | 5               | Nil   | Temporal pallor of both discs.  | SLO 3i, b.d.<br>Yeast 3i, b.d.   | 2<br>2                          | R. 6/36.<br>L. 6/36.<br>No further improvement in vision.  |

TABLE—concl'd.

| Number | Age and sex | Vision             | Duration, years | Signs of deficiency disease | Fundus examination             | Treatment                      | Duration of treatment in months | Results  |
|--------|-------------|--------------------|-----------------|-----------------------------|--------------------------------|--------------------------------|---------------------------------|--|
| 11     | 30, M.      | R. 6/18<br>L. 6/18 | 3               | Nil                         | Temporal pallor of both discs. | SLO 5i, b.d.                   | 1½                              | R. 6/12.<br>L. 6/12.   |
| 12     | 19, F.      | R. 4/60<br>L. 3/60 | 5               | Red raw tongue.             | Do.                            | SLO 5i, b.d.<br>Yeast 5i, b.d. | 3<br>1½                         | R. 6/36. L. 6/36. Tongue unchanged.<br>Tongue healed but no further improvement in vision. |
| 13     | 25, M.      | R. 3/60<br>L. 3/60 | 4               | Angular stomatitis.         | Do.                            | Yeast 5i, b.d.<br>SLO 5i, b.d. | 2<br>2                          | R. 6/60. L. 6/60.<br>R. 6/36. L. 6/36.   |

No cases except Nos. 7 and 9 showed improvement in vision from glasses before treatment.  
No. 7 improved to R. 6/24 and L. 6/24 and No. 9 to R. 6/12 and L. 6/18.  
SLO = Shark-liver oil.

### Discussion

It has been shown by numerous workers that pathological changes in the nervous system occur as a result of vitamin-A deficiency. The literature of this subject was reviewed by Rao (1936), who carried out an extensive investigation on the effect of vitamin-A deficiency on peripheral nerves. The same worker (1938) observed myelin degeneration in the optic nerve of rabbits, rats and fowls, fed on diets lacking in vitamin A. Treatment with carotene (Rao, 1940) cured xerophthalmia in the deficient animals, but not the anatomic nervous lesions. No signs of impairment of nerve function were observed in the deficiently-fed animals. Rao (1938) expressed the following views: 'A considerable series of observations, including those reported here, point to the conclusion that vitamin A is related to the integrity of the nervous tissues, but at the same time it appears that myelin degeneration may be associated with various forms of dietary error'.

Retrobulbar neuritis followed by partial optic atrophy in African patients has been described by Moore in a series of articles, three of which (1937a, b; 1939) are available in Coonoor. The ophthalmic condition described by him was usually found in association with signs of riboflavin deficiency. The same association was observed in a proportion of the present series of cases. Pallor of the disc with impairment of vision in malnourished cases has been observed by St. John in Barbados (Moore, 1937b). Moore reported that treatment with yeast and marmite produced excellent results, while cod-liver oil was ineffective. Some of his cases were given both yeast and cod-liver oil.

Métivier (1941b), working in Trinidad, has recently reported 'nutritional amblyopia', characterized by pallor of the temporal portion of the optic disc. He ascribes this to vitamin B<sub>2</sub> deficiency. He states that keratomalacia is rare in Trinidad and considers vitamin A deficiency unimportant in the island. He has, however (1941a), reported the existence there of xerophthalmia and Bitot's spots caused by vitamin A deficiency.

Cases treated in the present investigation appeared to respond more satisfactorily to large doses of vitamin A than to yeast. A number of cases showed xerosis and phrynodema, which are usually considered signs of vitamin-A deficiency. The dosage of yeast given to the patients in Madras was smaller than that given by Moore. It was sufficient, however, to clear up oral signs of riboflavin deficiency in certain cases without concurrent improvement in vision. For practical clinical purposes, treatment with yeast and fish-liver oil simultaneously may be recommended.

The untreated condition does not appear to progress to permanent blindness—a point noted by Moore and also by St. John. The author paid a visit to the Institute for the Blind in Poonomalee near Madras, in order to discover whether any of the inmates had been admitted for total optic atrophy which could be suspected of being a more advanced stage of the condition described in this paper. No such cases were found.

It is of interest to refer to an article entitled 'A common deficiency disease met with in out-patient practice' (Verghese, 1936). Verghese described a syndrome frequently observed in Malabar in the following terms:—

The syndrome of symptoms consists of the following:—

1. A chronic keratoderma characterized by a minute warty eruption affecting specially the outer surface of the lower and upper extremities, which has a Malayalam cognomen called 'kara'.

(N.B.—This is the condition now\* known as phrynodema.)

2. Sore-mouth.

3. A group of eye symptoms consisting of:—

\*The condition was first described and named by L. Nicholls in this journal in 1933, *I. M. G.*, 68, 681—Editor.

- (i) Night-blindness.
- (ii) Xerosis.
- (iii) Impairment of vision of varying degree.
- (iv) Conjunctivitis with slight lacrymation and photophobia.

Verghese did not report temporal pallor in cases showing impairment of vision; he says, in fact, that ophthalmoscopic examination revealed no remarkable changes in the retina except a slight hyperæmic condition of the vessels. There is, however, considerable similarity between his syndrome and the conditions other than temporal pallor observed in the group of patients described in this paper. His description illustrates the close clinical association between signs of vitamin-A and vitamin-B<sub>2</sub> deficiency in malnourished patients. He observed that the syndrome was very common in malnourished children in orphanages.

There seems little doubt that partial optic atrophy can be added to the growing list of vitamin-deficiency diseases of public-health importance. Careful examination of groups of malnourished school-children would probably reveal that mild degrees of impairment of vision associated with some degeneration of the optic nerve were very common.

#### Summary

1. A description is given of a series of cases of partial degeneration of the optic nerve, evidenced by pallor of the temporal half of the optic disc. In many cases there is serious impairment of vision.

2. A large percentage of the patients were suffering from deficiency diseases.

3. Treatment with shark-liver oil led to improvement, particularly in milder cases.

4. It is concluded that the condition is due to diet deficiency.

#### Acknowledgments

The author wishes to express his grateful thanks to the superintendent of the Government Ophthalmic Hospital, Madras, Rao Bahadur K. Koman Nair, for co-operation in the investigation. Gratitude is also due for assistance from other members of the hospital staff.

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## RIBOFLAVIN AND ITS ROLE IN NUTRITION

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### Section 1

RIBOFLAVIN—AN IMPORTANT MEMBER OF THE VITAMIN B<sub>2</sub> COMPLEX—ITS ISOLATION AND IDENTIFICATION—CHEMISTRY, PROPERTIES AND SYNTHESIS—ITS ANALOGUES—THE SPECIFICITY OF ITS STRUCTURE FOR VITAMIN ACTIVITY

RIBOFLAVIN is an yellowish-green water-soluble pigment which occurs throughout the plant and animal kingdoms. It is one of the important vitamins belonging to the vitamin B<sub>2</sub> group, and was the first factor to be separated from the group. This occurred in 1933. Since then three more vitamins included in the complex have been isolated in a pure state. According to present knowledge, the vitamin B<sub>2</sub> complex includes the following:—

1. *Riboflavin*.—Essential in the nutrition of human beings and various animals used in laboratory experiments. Prevents and cures cheilosis, angular stomatitis, a certain type of glossitis, scaly dermatitis of the scrotum and superficial keratitis in human beings. The terms 'flavin' and 'lactoflavin' have been employed, but 'riboflavin' is now coming into general use.

2. *Nicotinic acid and its amide*.—This has been identified with the pellagra-preventive vitamin. It has a curative action on certain types of stomatitis and glossitis, unaccompanied by other signs of pellagra, and also on sprue.

3. *Pyridoxin (vitamin B<sub>6</sub>)*.—This prevents or cures so-called 'rat-pellagra' and also a form of microcytic anæmia produced by faulty diet in rats and pigs. Its rôle in human nutrition is not yet clear.

4. *Pantothenic acid*.—This prevents a 'pellagra-like' condition in chickens. It has a growth-promoting effect on rats, dogs and pigs. It prevents or cures adrenal hæmorrhage in rats. Its function in the nutrition of human beings remains to be discovered.

5. *Filtrate factors*.—These factors have not yet been isolated in a pure state. They are known at present by their growth-promoting effect on experimental animals. There is good evidence for the existence of at least two different factors.

*Isolation of riboflavin from natural sources*.—There is much confusion in the literature from 1926–1941 with regard to the nomenclature of the different vitamins of the B<sub>2</sub> complex. In 1927, the heat-stable vitamin complex in yeast was named 'vitamin B<sub>2</sub>' in England and 'vitamin G' in America. Most workers have followed this nomenclature but certain workers in Germany and America have applied the term B<sub>2</sub> and G to riboflavin only.

Until 1933 it was not suspected that the water-soluble yellow pigment of milk was of

unique importance in nutrition. As long ago as 1879, Blyth, an English food chemist, isolated the pigment in an impure state and named it 'lactochrome'. In 1925 Bleyer and Kahlmann obtained an impure preparation of the yellow pigment of milk. The next important investigation was that of Warburg and Christian in 1932. They isolated a new oxidation enzyme from aqueous extracts of yeast, and named it 'yellow respiratory pigment'. They showed that it consisted of a protein and a pigment component displaying greenish-yellow fluorescence.

In 1933 there appeared reports from three different laboratories suggesting that the greenish-yellow fluorescent pigments present in milk, liver, eggs and yeast were related to, or identical with, the pigment isolated by Warburg and Christian from their 'yellow respiratory enzyme', and vitamin B<sub>2</sub> or G (Kühn, György and Wagner-Jauregg, 1933; Ellinger and Koschara, 1933; Booher, 1933). The credit for isolating the pigment in a pure state, and its identification as one of the vitamins of the B<sub>2</sub> complex by its growth-promoting effect, goes to Kühn and his group, who had in the course of earlier work observed a parallelism between vitamin B<sub>2</sub> activity and the intensity of the yellow colour or of the greenish-yellow fluorescence of active extracts.

They found that both the vitamin and the pigment were destroyed by exposure to light. In 1933, they isolated in a pure crystalline state the water-soluble yellow pigment from egg white and milk, and reported that the crystalline product, in daily doses of 100 µg., had a growth-promoting effect on vitamin B<sub>2</sub> deficient rats. They suggested the chemical group name of 'flavin' for these pigments and pointed out that they were probably identical with the yellow pigment of Warburg and Christian. At about the same time, Ellinger and Koschara (*loc. cit.*) and Booher (*loc. cit.*) prepared highly potent preparations of the pigment, and suggested that the pigment was probably identical with vitamin B<sub>2</sub> or G. Since then riboflavin has been isolated from a wide variety of animal and plant substances including egg white (Kühn, György and Wagner-Jauregg, *loc. cit.*), milk (Kühn, Rudy and Wagner-Jauregg, 1933), liver (Karrer, Solomon and Schopp, 1934), kidney (Karrer, 1936), urine (Koschara, 1934), barley malt (Karrer and Schopp, 1934b), dandelion blossoms (Karrer and Schopp, 1934a), grass (Kühn, Wagner-Jauregg, and Kaltschmitt, 1934), egg yolk (Karrer and Schopp, 1934c), retina of fish eyes (Euler and Adler, 1934) and fresh water algae (Heilbron, Parry and Phipers, 1935).

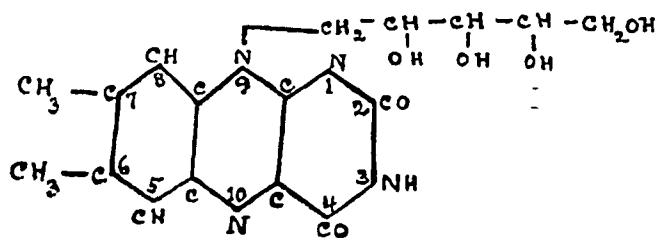
In their early work, Kühn and his co-workers (*loc. cit.*) obtained from 200 lb. of dried egg white, corresponding roughly to about 33,000 eggs, only 100 mg. of pure riboflavin. Later, however, they improved the yield.

At first the flavins isolated from different sources were called lactoflavin, ovoflavin, etc., etc. Subsequent work has shown that they are

all identical, and the name riboflavin was suggested and is now generally used, since all the flavins contain a carbohydrate d-ribose in their molecule.

**Properties.**—Riboflavin crystallizes as yellow-brown needles and is bitter to taste. It is slightly soluble in water (about 50 microgrammes in 1 c.c. of water at 20°C.) and in alcohol. It is relatively heat-stable in acid medium and stable even in strong acids. It is completely destroyed by prolonged exposure to strong sunlight or ultra-violet light, and also by cold or hot alkali. It is not altered by exposure to atmospheric air. By the action of certain reducing agents, e.g. sodium hydrosulphide, it loses its colour by being converted into the reduced form. It can be reoxidized by oxygen or mild oxidizing agents to the coloured form.

**Structure and synthesis.**—The chemical structure of riboflavin has been established as the following by Kühn and his co-workers (Kühn and Rudy, 1934a, b).



Riboflavin [6 : 7 dimethyl-9-(d-ribityl)-isoalloxazine]

Its synthesis has been achieved by Kühn and Karrer and their respective co-workers (Kühn, Reinmund, Weygand and Strobile, 1935; Karrer, Becker, Benz, Frei, Solomon and Schopp, 1935; Karrer and Meerwin, 1936). In the method of Karrer and Meerwin (*loc. cit.*) an improved yield of 38 per cent of the theoretical was obtained. Starting with 2 g. of d-ribose they obtained approximately 2 g. of riboflavin. The chief difficulty in the synthesis of riboflavin is the poor yields obtained in the preparation of the essential d-ribose.

**Analogues of riboflavin and specificity of structure for full biological activity.**—Synthesis of various analogues of d-riboflavin has demonstrated that the number of structural alternatives with the biological activity of riboflavin is limited. The data given in table I illustrate

TABLE I  
The relation of structure of riboflavin and its analogues to vitamin activity

| Compound  | Vitamin activity              |
|---|-------------------------------|
| 6 : 7-dimethyl-9(d-ribityl)-isoalloxazine (natural d-riboflavin). | Fully active                  |
| 6 : 7-dimethyl-9(dl-aribityl)-isoalloxazine (ariboflavin).        | Half as active as riboflavin. |
| 7-monomethyl-9(dl-ribityl)-isoalloxazine                          | Active only in large doses.   |
| 6-monomethyl-9(dl-ribityl)-isoalloxazine                          |                               |
| 6-ethyl-7-methyl-9(dl-ribityl)-isoalloxazine                      |                               |
| 5-methyl-9(dl-ribityl)-isoalloxazine                              |                               |
| 8-methyl-9(dl-ribityl)-isoalloxazine                              | Inactive                      |
| 9(dl-ribityl)-isoalloxazine.                                      |                               |

this point. They show that the position and kind of substituent group in the benzene ring, and the nature of the carbohydrate side chain in position 9, seem to determine vitamin activity.

### Section 2

#### RIBOFLAVIN DEFICIENCY (ARIBOFLAVINOSIS) IN HUMAN BEINGS

Riboflavin deficiency in man was first described by Sebrell and Butler in 1938 in the United States of America. They reported the experimental production, in human subjects fed on a deficient diet (Sebrell and Butler, 1938; 1939), of a clinical syndrome in which lesions of the lips, accompanied by a greasy dermatitis around the naso-labial folds, were prominent signs. In some cases dermatitis in the neighbourhood of the eyes and ears was also observed. All these signs were cured by the administration of pure synthetic riboflavin, in daily doses of 5 to 10 mg. for a week or more. The syndrome was named 'ariboflavinosis'. Later Kruse, Sydenstricker, Sebrell and Cleckley (1940) reported that a specific type of glossitis, different from that seen in pellagra, occurred in subjects showing cheilosis and seborrhoeic dermatitis. Kruse *et al.* (*loc. cit.*) made the important observation that superficial keratitis occurs in patients showing other signs of riboflavin deficiency, and found that riboflavin had a remarkable curative action on this condition. In the same year, Hou (1940), in China, described the successful treatment of 36 cases of the same nature, by administering 5 to 15 mg. doses of pure riboflavin. Recently Aykroyd and Verma (1942) have reported the high incidence of superficial keratitis associated with stomatitis and/or scaly dermatitis of the scrotum in South India and the rapid curative action of pure riboflavin in the above conditions. All these investigators have administered daily doses of either 2 to 5 mg. by injection, or 5 to 15 mg. by the oral route, for periods of one week or more. Aykroyd and Verma further reported that the condition tended to recur after a period of a few weeks after the cessation of treatment, when the subjects returned to their usual riboflavin deficient diets.

#### *Riboflavin deficiency in experimental animals*

György (1935) and Chick, Copping and Edgar (1935) found that rats fed on a diet deficient in riboflavin develop a non-specific dermatitis. Cure was brought about by the daily administration of 20  $\mu$ g. of riboflavin.

Day and his co-workers (1938) reported the development of cataract in rats fed on diets deficient in riboflavin. They found that riboflavin prevented the occurrence of this type of cataract but could not cure a cataract once formed.

*The dog.*—Sebrell and Onstott (1938) have described a condition in dogs, called by them 'yellow liver', which is caused by the deficiency

of riboflavin in the diet. The signs characteristic of the acute attack of 'yellow liver' developed rapidly and death occurred in a few hours. The most striking changes occurred in the liver which was yellow in colour with fine red lobular markings. It was firm and often distinctly greasy to touch. The liver cells were filled with fat droplets.

The fact that riboflavin is essential in the nutrition of the chick and the pig has also been demonstrated by various groups of workers (Norris *et al.*, 1936; Lepkovsky and Jukes, 1936).

### Section 3

#### METHODS FOR THE ESTIMATION OF RIBOFLAVIN IN FOODSTUFF, ANIMAL TISSUES AND URINE

For the investigation of the physiological and biochemical rôle of riboflavin in human beings and experimental animals, simple methods for the quantitative estimation of the riboflavin present in foodstuffs, animal tissues and urine are essential. Many methods have been described. They may be broadly classified as follows:—

##### (a) *Biological methods*

1. Based on the growth of young rats (Bourquin and Sherman, 1931; El Sadr, Macrae and Work, 1940).

2. Based on the growth of *Lactobacillus casei* (Snell and Strong, 1939; Fraser, Topping and Isbell, 1940; Strong, Feeney, Moore and Parsons, 1941; Sebrell, Butler, Wooley and Isbell, 1941).

##### (b) *Physico-chemical methods*

1. Colorimetric estimation of the yellowish-green colour of the extracts obtained after various methods of purification (Koschera, 1935; Emmerie, 1938; Wilson and Roy, 1938).

2. Determination of the fluorescence of the purified extracts by a fluorimeter, colorimeter or photometer (Euler and Adler, *loc. cit.*; Murthy, 1937; Wilson and Roy, *loc. cit.*; Emmerie, 1938; Sullivan and Norris, 1939; Hodson and Norris, 1939; Swaminathan, 1942a).

3. Determination of the yellowish-green colour or of the fluorescence of lumiflavin formed by the irradiation of riboflavin in alkaline medium (Warburg and Christian, 1933; Kühn, Wagner-Jauregg and Kaltschmitt, *loc. cit.*; Wilson and Roy, *loc. cit.*; Shaw, 1939).

It is generally agreed that the results obtained by the biological methods are more reliable than those obtained by physico-chemical methods, which are limited in their value either because they are not specific for riboflavin or because all the riboflavin present in the biological materials is not estimated. Recently the writer (Swaminathan, 1942a) has made a critical study of the fluorimetric method and has introduced certain improvements. The chief advantages of the improved method over the existing methods are: (1) all the riboflavin present is

extracted and estimated, and (2) corrections to allow for the errors due to the presence of other interfering fluorescent substances and pigments are introduced. The method is simple and has been found to yield results corresponding well with existing biological data. It has been applied to the study of the distribution of riboflavin in foods and also to studies on the excretion of riboflavin in human beings and experimental animals (Swaminathan, 1942a, b and c). Recently Najjar (1941) has also described an improved fluorimetric method for the estimation of riboflavin in human urine.

#### Section 4

#### RIBOFLAVIN CONTENT OF FOODSTUFFS

A knowledge of the riboflavin content of food-stuffs is necessary for planning satisfactory diets. Some of the more recent data for common foods (1938-1942), obtained by different workers using improved biological or physico-chemical methods, are given in table II. For a more exhaustive list, the reader may be referred to a recent publication by Boas Fixsen and Roscoe (1940).

*Cereals.*—Whole cereals, as a group, are poor sources of riboflavin, containing from 0.5 to 1.2  $\mu\text{g./g.}$  It is interesting to note that whole cereals are fairly good sources of vitamins B<sub>1</sub> and B<sub>6</sub>,

TABLE II  
*Riboflavin content of foodstuffs*

|                                     | Riboflavin<br>$\mu\text{g./g.}$ |
|-------------------------------------|---------------------------------|
| <i>Cereals and cereal products—</i> |                                 |
| Cambu .. ..                         | 1.2 (g)                         |
| Cholam .. ..                        | 1.1 (g)                         |
| Maize .. ..                         | 0.6 (a), 0.6 (b)                |
| Oats .. ..                          | 1.1 (b)                         |
| Ragi .. ..                          | 0.5 (g)                         |
| Rice, raw, undermilled .. ..        | 0.7 (a)                         |
| Rice, raw, milled .. ..             | 0.3 (g)                         |
| Rice, parboiled, milled .. ..       | 0.8 (g)                         |
| Rice, polishings, raw .. ..         | 3.0 (g)                         |
| Whole wheat .. ..                   | 0.4 (a), 0.8 (b), 1.2 (g)       |
| White flour .. ..                   | 0.4 (b)                         |
| <i>Pulses—</i>                      |                                 |
| Bengal gram .. ..                   | 3.3 (a)                         |
| Black gram .. ..                    | 3.0 (a), 1.8 (g)                |
| Green gram .. ..                    | 1.1 (a)                         |
| Lentil .. ..                        | 3.0 (a)                         |
| Red gram .. ..                      | 3.5 (a), 2.5 (g)                |
| Soya bean .. ..                     | 2.8 (b), 2.4 (g)                |
| Peanuts .. ..                       | 2.4 (g)                         |
| <i>Vegetables—</i>                  |                                 |
| Amaranth leaves .. ..               | 0.6 (a)                         |
| Brinjal .. ..                       | 0.6 (a)                         |
| Cabbage .. ..                       | 0.5 (g)                         |
| Carrot .. ..                        | 0.4 (g)                         |
| Ladies fingers .. ..                | trace (a)                       |
| Potato .. ..                        | 1.0 (a)                         |
| Pumpkin .. ..                       | 0.5 (a)                         |
| Spinach .. ..                       | 1.6 (a)                         |
| Sweet potato .. ..                  | 0.5 (a)                         |
| <i>Fruits—</i>                      |                                 |
| Apple .. ..                         | 0.3 (a), 0.04 (d)               |
| Lime juice .. ..                    | 0.1 (a)                         |
| Mango .. ..                         | 0.6 (a)                         |
| Orange .. ..                        | 0.5 (a), 0.3 (d), 0.4 (g)       |
| Papaya .. ..                        | 0.2 (a), 0.5 (d), 0.3 (g)       |
| Pears .. ..                         | 0.7 (a), 0.2 (d)                |
| Plantain .. ..                      | 0.5 (a)                         |
| Tomato .. ..                        | 0.4 (d), 0.4 (g)                |

TABLE—concl'd.

|  | Riboflavin<br>$\mu\text{g./g.}$ |
|--|---------------------------------|
| <i>Milk—</i>   |                                 |
| Milk, cow's, fresh .. ..   | 1.7, 1.8 (g)                    |
| Skimmed milk powder .. ..  | 20.0 (b), 16.5 (g)              |
| <i>Flesh foods—</i>  |                                 |
| Beef, fresh .. ..  | 1.9 (c)                         |
| Beef, liver, fresh .. ..   | 32.0 (c)                        |
| Egg, whole, fresh .. ..  | 4.5 (c)                         |
| Fish, muscle, fresh .. ..  | 1 to 2 (f)                      |
| Fish, liver, fresh .. ..   | 3 to 12 (f)                     |
| Pork, muscle, fresh .. ..  | 2.7 (c)                         |
| Pork, liver, fresh .. ..   | 29.0 (c)                        |
| Sheep, muscle .. ..  | 3.2 (g)                         |
| Sheep, liver .. ..   | 47.1 (g)                        |
| <i>Yeast, dried—</i>   |                                 |
| Yeast, brewer's, dried .. ..                                       | 53.4 (b), 55.5 (g)              |
| Yeast, dried (Torula strain, grown on molasses salts medium) .. .. | 64.8 (g)                        |
| Yeast, dried, distillery .. ..                                     | 23.0 (g)                        |
| (a) Wilson and Roy (1938) (rat-growth method).                     |                                 |
| (b) Hodson and Norris (1939) (fluorimetric).                       |                                 |
| (c) Mickelson, Waisman and Elvehjem (1939) (bacterial).            |                                 |
| (d) Lanford, Finkelstein and Sherman (1941) (rat growth).          |                                 |
| (e) Sherman and Lanford (1939) (rat growth).                       |                                 |
| (f) Lunde, Kringsted and Olsen (1938) (fluorimetric).              |                                 |
| (g) Swaminathan (1942a) (fluorimetric).                            |                                 |

containing on the average about 4  $\mu\text{g./g.}$  of vitamin B<sub>1</sub> and 7  $\mu\text{g./g.}$  of vitamin B<sub>6</sub> (Aykroyd, Krishnan, Passmore and Sundararajan, 1940; Swaminathan, 1941; Swaminathan, 1942a). Raw rice polishings are not rich in riboflavin, containing about 3  $\mu\text{g./g.}$ ; this figure may be compared with their high content of vitamin B<sub>1</sub> (24  $\mu\text{g./g.}$ ), vitamin B<sub>6</sub> (19  $\mu\text{g./g.}$ ) and nicotinic acid (28 mg./100 g.). Sixteen oz. of cereals, whole or milled, will probably supply from 200 to 400 microgrammes of riboflavin daily.

*Pulses.*—Pulses are in general slightly better sources of riboflavin than cereals, but resemble cereals in that their riboflavin content (1.5 to 3  $\mu\text{g./g.}$ ) is lower than their content of vitamin B<sub>1</sub> or B<sub>6</sub>. Three to four oz. of pulses will supply from 150 to 300  $\mu\text{g.}$  of riboflavin.

*Vegetables and fruits.*—Vegetables and fruits are poor sources of riboflavin, containing amounts varying from 0.2 to 1  $\mu\text{g./g.}$  Leafy vegetables are in general better sources than non-leafy vegetables. A daily intake of 6 oz. of vegetables and 4 oz. of fruits will supply 150 to 300  $\mu\text{g.}$  of the vitamin.

*Milk and eggs.*—Fresh cow's milk is a good source of riboflavin, containing about 1.5 to 2 microgrammes per ml. One pint (20 oz.) of milk will supply about 1 mg. of riboflavin. Skimmed milk powder is one of the richest sources, containing 20  $\mu\text{g./g.}$  Eggs are also fairly rich, containing 4 to 5  $\mu\text{g./g.}$

*Flesh foods.*—Fresh liver (mammalian) is one of the richest natural sources of riboflavin, containing 30 to 50  $\mu\text{g./g.}$  Meat and fish muscle are fair sources, containing from 2 to 3 microgrammes per g. A daily intake of 1 oz. of liver will supply about 1 mg. of riboflavin.



**Dried yeast.**—Dried brewer's yeast is a good source, containing 50 to 60 microgrammes per g. Dried yeast (*Torula* strain) grown on a molasses salts medium in this laboratory compared well in its riboflavin content with brewer's yeast, containing 60–80  $\mu\text{g./g.}$  Dried distillery yeast was found to be a fair source (23  $\mu\text{g./g.}$ ).

It is evident from table II that milk is probably the most important and dependable source of riboflavin in human dietaries, though fresh liver and dried yeast, even when taken daily in small quantities (1 oz.), will supply as much as a pint of milk—almost the daily requirements. The majority of foods included in the diets consumed by the poorer classes in India are low in riboflavin.

### Section 5

#### DAILY REQUIREMENTS OF RIBOFLAVIN FOR HUMAN BEINGS

Examination of the riboflavin content of diets consumed by those suffering from 'ariboflavinosis' (Sebrell *et al.*, *loc. cit.*; Aykroyd and Verma, *loc. cit.*) shows that the daily riboflavin intake of such individuals is probably in the range of 300 to 500 microgrammes. Reliable data with regard to the absolute amounts of riboflavin required for normal nutrition in human beings of all ages are at present lacking. A few estimates of probable daily requirements are, however, available (Stiebling, 1937; Rose, 1937; Sebrell *et al.*, 1941). They are given in table III.

It appears to be justifiable to conclude that the *minimum* requirements of riboflavin are probably of the order of 1.2 to 1.5 mg. (1,200–1,500 microgrammes), a conclusion in accordance with the estimates of Stiebling and Rose. The optimum amount, *i.e.* the desirable intake, is probably in the order of 3 mg., as suggested by Sebrell *et al.* (*loc. cit.*). The following standards of intake may be suggested:—

#### Daily requirements of riboflavin for adult human beings

|                     |       |              |
|---------------------|-------|--------------|
| Minimum requirement | 1,500 | microgrammes |
| Optimum intake      | 3,000 | "            |

### Section 6

#### METABOLISM OF RIBOFLAVIN IN HUMAN BEINGS AND EXPERIMENTAL ANIMALS

**Metabolism in human beings.**—Studies on the urinary excretion of riboflavin by human beings have been reported by different workers (Emmerie, 1936; Sebrell, Butler, Wooley, and Isbell, *loc. cit.*; Swaminathan, 1942b). A summary of the results of these investigations is given in table IV. It is evident from the results that the urinary excretion of riboflavin is related to the intake and that subjects suffering from riboflavin deficiency excrete less of a test dose than normal human beings. Much more work is necessary before an indirect method, based on urinary excretion, for the detection of partial riboflavin deficiency in human beings, can be developed.

TABLE III

#### Daily requirements of riboflavin for human beings

| Author                       | Subjects  | DAILY REQUIREMENTS OF RIBOFLAVIN  |   |
|------------------------------|---|---|---|
|                              |   | Bourquin-Sherman units  | Microgrammes*   |
| Stiebling (1937)             | Boys under 6 years of age<br>Girls under 7 years of age   | 450   | 1,350   |
| " (1937)                     | Boys, 7 to 10 years of age<br>Girls, 8 to 13 years of age | 540   | 1,620   |
| " (1937)                     | Other children and adults                                 | 600   | 1,800   |
| Rose (1937)                  | Children up to 10 years of age                            | 400   | 1,200   |
|                              | Adults  | 20 units for 100 calories,<br><i>i.e.</i> 500 units for 2,500 calories. | 60 units per 100 calories,<br><i>i.e.</i> 1,500 for 2,500 calories. |
| Sebrell <i>et al.</i> (1941) | Adults  | ..  | 3,000   |

\*According to Sherman and Lanford (1939), the results of 17 available independent investigations show an average of  $67 \pm 3$  Bourquin-Sherman units of riboflavin per 100 g. of milk. Taking the average riboflavin content of cow's milk as 2  $\mu\text{g./g.}$  (values range from 1.5 to 2  $\mu\text{g./g.}$ ), 1 Bourquin-Sherman unit is about equivalent to 3  $\mu\text{g.}$  This figure has been used to convert Bourquin-Sherman units into microgrammes in table III.

TABLE IV

The urinary excretion of riboflavin in human beings before and after test doses of riboflavin

| Investigators                                | Subjects (diagnosis) | Dietary intake of riboflavin, $\mu$ g. | Initial 24 hours urinary excretion, $\mu$ g. | Test dose, $\mu$ g. | Response to first test dose, $\mu$ g.                         |
|--|----------------------|--|--|---------------------|---|
| Emmerie (1936) ..                            | Normal 1             | ..                                     | 952  | 5,710               | 3,283   |
| " (1936) ..                                  | " 2                  | ..                                     | 885  | 4,240               | 1,197   |
| Sebrell <i>et al.</i> (1941) ..              | Normal               | 2,540-3,680                            | 793-1,265                                    | 5,000               | 50-80 per cent.   |
| " (1941) ..                                  | 'Ariboflavinosis'    | 500                                    | 24-119                                       | 2,000               | The excretion rose from 34 $\mu$ g. to 1,484 on the 20th day. |
| Swaminathan (1942a) ..                       | One normal subject   | 1,250-1,500                            | 320-400                                      | 5,000               | About 80 per cent of test dose (4,295) was excreted.          |
| Swaminathan and Verma (unpublished results). | 'Ariboflavinosis'    | 400-500                                | 50-200                                       | 5,000               | About 10-20 per cent (416-508) was excreted.                  |

*Balance experiments in rats.*—Riboflavin 'balance' experiments on experimental animals have been reported by Fraser, Topping and Isbell (*loc. cit.*) and Swaminathan (1942c). These workers have shown that the riboflavin content of liver, muscle, and heart of rats fed on a diet deficient in this factor was lower than in the controls receiving riboflavin supplements. Fraser *et al.* (*loc. cit.*) obtained similar results in dogs.

### Section 7

#### THE BIOCHEMICAL ROLE OF RIBOFLAVIN AND OTHER B VITAMINS IN THE ANIMAL ORGANISM

Recent investigations have demonstrated the close relationship between certain vitamins of the B complex, *e.g.* vitamin B<sub>1</sub> (aneurin, thiamine), riboflavin and nicotinic acid, in the biological oxidation processes taking place in all the cells of the animal organism. Several of the coenzymes concerned in these processes contain one of the B vitamins as a prosthetic group in their molecules. The activity of these coenzymes is mainly due to the prosthetic group, *i.e.* the vitamin. These vitamin complexes (*i.e.* coenzymes, in conjunction with certain other enzymes which are of a protein nature) carry on the various biochemical processes. They act as it were like locks and keys. Riboflavin phosphoric acid, in combination with adenylic acid and a specific protein, is a very important member of the oxidative chain in metabolism. Similarly, nicotinic acid amide (the anti-pellagra vitamin), in combination with d-ribose, adenylic acid and phosphoric acids, constitutes what are known as coenzymes I and II. Vitamin B<sub>1</sub> pyrophosphate, known as co-carboxylase, is the coenzyme which, in conjunction with another enzyme, carboxylase, decarboxylates pyruvic acid and certain other ketonic acids.

Lactic acid is a common metabolite found in almost all normal tissues and cells. There are many processes by which lactic acid is metabolized in the tissues. One of these is represented by the following scheme :—

Lactic acid  $\rightarrow$  pyruvic acid  $\rightarrow$  carbon dioxide and water,

It has been demonstrated by a group of workers in Cambridge (Corran, Green and Straub, 1939) that coenzyme I (containing nicotinic acid amide) and alloxazine-adenine-dinucleotide-protein (containing riboflavin), isolated from heart muscle, are essential in the biological oxidation of lactic acid to pyruvic acid.

According to these workers the reaction takes place as follows :—

I Lactic acid + lactic dehydrogenase + coenzyme I  $\rightarrow$  Pyruvic acid + reduced coenzyme I.

II Reduced coenzyme I + flavoprotein (heart)  $\rightarrow$  coenzyme I + reduced flavoprotein.

III Reduced flavoprotein + cytochrome b  $\rightarrow$  flavoprotein + reduced cytochrome b.

Peters and his co-workers in Oxford (Banga, Ochoa and Peters, 1939) have demonstrated that, in the metabolism of the brain, vitamin B<sub>1</sub> pyrophosphate (*i.e.* co-carboxylase) is essential for the oxidative removal of pyruvic acid according to the following scheme :—

IV Pyruvic acid + carboxylase + co-carboxylase (vitamin B<sub>1</sub> pyrophosphate)  $\rightarrow$  CO<sub>2</sub> + H<sub>2</sub>O.

In the course of their earlier work, Peters and his co-workers found that both lactic acid and pyruvic acid accumulate in the brains of pigeons in B<sub>1</sub> deficiency. An explanation of this fact was offered by Green and Brosteaux (1936) who showed that pyruvic acid is a potent inhibitor of the enzyme lactic dehydrogenase (0.04 M pyruvate causing 100 per cent inhibition) so that accumulation of pyruvic acid, as in vitamin B<sub>1</sub> deficiency, will inhibit the oxidation of lactic acid to pyruvic acid, resulting in the accumulation of lactic acid also.

It is clear from the foregoing that in the chain of the oxidative removal of lactic acid *via* pyruvic acid to carbon dioxide and water, all the three vitamins, *viz* riboflavin, nicotinic acid

amide and vitamin B<sub>1</sub>, are essential, and the absence of any one of these will interfere in the part played by others. There is also evidence that flavoproteins play an important rôle in the oxidative removal of many other metabolites, viz d-amino acids, acetaldehyde, succinic acid, xanthine, pyruvic acid, fumaric acid reduction, ethyl alcohol, phosphoglyceraldehyde, hexonic acid, glucose, glutamic acid and iso-citric acid.

At present no explanation can be offered as to why deficiency of riboflavin in the diet, which must adversely affect the vital processes taking place in every cell in the body, should manifest itself clinically by lesions of the eyes, tongue and skin. This is a problem for future investigation.

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ON SOLUBLE SULPHANILAMIDE  
DERIVATIVES

## PART I

## TOXICITY AND ABSORPTION

By A. N. BOSE, M.B.

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IN any sulphanilamide therapy, it is the concentration of the drug in blood that determines its therapeutic efficacy. The amount of the drug itself in the circulating blood should always be determined by actual quantitative estimation (Hansen, 1939). Under ordinary conditions sulphanilamide taken by mouth is rapidly absorbed from the gastro-intestinal tract and is found in practically all the body fluids at the therapeutic level; but when a very rapid effect is necessary, when it is difficult for the patient to swallow the tablets, when nausea and vomiting are pronounced, or when conditions do not allow the easy establishment of a proper concentration of the drug in blood, parenteral administration becomes a necessity. The solubility of sulphanilamide in water at the body temperature, however, is low (about 1.5 mg. per cent) and therefore there is needed a soluble compound with a very low toxicity. The earliest soluble compound was the complex coloured azo salt, Prontosil soluble, which is often found to be less efficacious (Jauerneck and Gueffroy, 1937), and is now almost obsolete (Whitby, 1938). The disodium salt of  $\gamma$ -phenyl propyl-amino phenyl sulphonamide disulphonic acid (*cf.* Goissidet and Despois, 1937) is found to be less toxic (Halpern and Mayer, 1937). Although various soluble derivatives are being constantly used for parenteral administration their relative toxicity has not been thoroughly established, and the possibility of establishing by parenteral administration a high concentration in the blood has not been thoroughly studied. Accordingly work of the nature was considered to be of interest, and the

characteristics of certain soluble compounds are described in the body of this paper.

*Experimental*

The compounds that have been studied are I,  $\gamma$ -phenyl propyl amino phenyl sulphonamide  $\alpha$ :  $\gamma$ -disodium sulphonate; II,  $\gamma$ -phenyl propyl amino phenyl sulphacetamide  $\alpha$ :  $\gamma$ -disodium sulphonate, prepared by treating Schiff's base from cinnamic aldehyde and sulphanilacetamide with sodium bisulphite; III, sodium salt of sulphanilacetamide; IV, glucose derivative (m.p. 188°) of sulphanilacetamide.

*Toxicity.*—The toxicity in mice of a single dose of all the compounds was first ascertained. Groups of white mice weighing from 18 to 20 gm. were given intravenously different doses of a solution of known pH of each of the compounds. The animals were left for 96 hours. The results are recorded in table I. Subsequently the toxicity of the drugs given subcutaneously was ascertained in a different group of animals. The observations have been recorded in table II.

*Concentration in blood.*—For purposes of comparison sulphanilamide itself in one per cent solution was given to a group of mice both orally and subcutaneously. Next each of the compounds I, II and III was administered subcutaneously to a group of 30 mice. The dose given in each case was the molar equivalent amount of sulphanilamide injected subcutaneously. For estimating the concentration in the blood, blood from the hearts of four mice was taken at intervals and pooled and the amounts of drug present in terms of free as well as total sulphanilamide were ascertained according to the modified technique as developed by Marshall and Litchfield (1938),  $\alpha$ -dimethyl naphthylamine being used as the coupling reagent. The drug concentrations attained in each case are recorded in table III in terms of pure sulphanilamide. The compound IV was found to be unstable in solution, and could not therefore be fully studied.

TABLE I

*Intravenous injections. Toxicity in mice. Weight of animal : 18 to 20 gm.*

| Compound | pH of the solution used | Dose mg./gm. | Mortality | Percentage mortality | Symptoms or remarks  |
|----------|-------------------------|--------------|-----------|----------------------|--|
| I        | 7.2                     | 3            | 0 : 15    | 0                    | Temporary shock, cardiac shock and death with respiratory failure. |
|          |                         | 4            | 0 : 10    | 0                    |  |
|          |                         | 6            | 0 : 10    | 0                    |  |
|          |                         | 7            | 3 : 10    | 30                   |  |
|          |                         | 8            | 9 : 12    | 75                   |  |
| II       | 4.95                    | 1            | 0 : 0     | 0                    | Hurried respiration, cardiac shock with respiratory failure.       |
|          |                         | 2            | 2 : 20    | 10                   |  |
|          |                         | 3            | 12 : 20   | 60                   |  |
|          |                         | 4            | 18 : 20   | 90                   |  |
| III      | 7.3                     | 3            | 0 : 12    | 0                    | Shock, dyspnoea followed by death with respiratory failure.        |
|          |                         | 4            | 4 : 16    | 25                   |  |
|          |                         | 6            | 9 : 16    | 56                   |  |
|          |                         | 8            | 10 : 10   | 100                  |  |
| IV       | 5.2                     | 2            | 0 : 5     | ..                   | Unstable solution.   |

TABLE II

*Subcutaneous injections. Toxicity in mice. Weight of animal : 18 to 20 gm.*

| Compound | Dose mg./gm. | Mortality | Percentage mortality | Symptoms   |
|----------|--------------|-----------|----------------------|--|
| I        | 10           | 0 : 12    | 0                    | Death with respiratory failure.  |
|          | 12           | 3 : 12    | 25                   |  |
|          | 16           | 6 : 12    | 50                   |  |
| II       | 5            | 0 : 10    | 0                    | " " " "  |
|          | 10           | 0 : 10    | 0                    |  |
|          | 12           | 0 : 20    | 0                    |  |
|          | 16           | 12 : 20   | 60                   |  |
|          | 20           | 17 : 20   | 85                   |  |
| III      | 25           | 10 : 10   | 100                  | " " " "  |
|          | 8            | 0 : 10    | 0                    |  |
|          | 10           | 3 : 12    | 25                   |  |
|          | 12           | 6 : 12    | 50                   |  |
|          | 16           | 9 : 12    | 75                   |  |
| IV       | 20           | 12 : 12   | 100                  | Dullness, paralysis of hind limbs, first quick and then slow respiration, cardiac shock, death with respiratory failure. |
|          | 6            | 0 : 10    | 0                    |  |
|          | 10           | 0 : 10    | 0                    |  |
|          | 14           | 5 : 10    | 50                   |  |
|          | 16           | 15 : 15   | 100                  |  |

TABLE III

*Drug concentration in blood of mice in terms of sulphanilamide*

| Compound       | Mode of administration | Dose mg./gm. | Hour of sample | CONCENTRATION IN MG. PER 100 C.C. OF BLOOD |         |                           |
|----------------|------------------------|--------------|----------------|--|---------|---------------------------|
|                |                        |              |                | Free                                       | Total * | Percentage of conjugation |
| Sulphanilamide | Oral                   | 0.5          | 1              | 32.0                                       | 32.0    | 0.0                       |
|                |                        |              | 2              | 30.0                                       | 31.0    | 3.2                       |
|                |                        |              | 3              | 22.3                                       | 26.8    | 16.7                      |
|                |                        |              | 4              | 19.1                                       | 19.4    | 1.5                       |
|                |                        |              | 5              | 11.7                                       | 14.1    | 17.2                      |
|                | Subcutaneous           | 0.1          | 24             | 0.76                                       | 1.25    | 39.2                      |
|                |                        |              | 1/2            | 7.8  | 7.75    | Nil                       |
|                |                        |              | 1              | 4.46                                       | 5.13    | 13.06                     |
|                |                        |              | 2              | 3.21                                       | 6.05    | 47.9                      |
|                |                        |              | 3              | 1.90                                       | 4.61    | 58.9                      |
| I              | Subcutaneous           | 0.3 †        | 5              | 1.04                                       | 2.32    | 55.2                      |
|                |                        |              | 24             | Nil  | Nil     | ..                        |
|                |                        |              | 1/2            | 3.38                                       | 4.71    | 28.2                      |
|                |                        |              | 1              | 2.66                                       | 3.05    | 12.8                      |
|                |                        |              | 2              | 3.38                                       | 5.0     | 32.4                      |
|                | Oral                   | 1.6 ‡        | 3              | 1.36                                       | 1.84    | 26.1                      |
|                |                        |              | 24             | Nil  | Trace   | ..                        |
|                |                        |              | 1/2            | 3.59                                       | 6.89    | 47.8                      |
|                |                        |              | 1              | 5.66                                       | 8.95    | 36.7                      |
|                |                        |              | 2              | 2.44                                       | 3.61    | 32.4                      |
| II             | Subcutaneous           | 0.31 †       | 3              | 2.46                                       | 3.59    | 31.4                      |
|                |                        |              | 24             | Nil  | Nil     | ..                        |
|                |                        |              | 1/2            | 4.4  | 5.7     | 22.8                      |
|                |                        |              | 1              | 1.22                                       | 2.14    | 42.9                      |
|                |                        |              | 2              | 1.29                                       | 2.33    | 44.6                      |
|                | Subcutaneous           | 0.139 †      | 3              | 1.0  | 1.46    | 31.5                      |
|                |                        |              | 24             | 1.08                                       | 1.94    | 44.3                      |
|                |                        |              | 1/2            | 6.09                                       | 7.69    | 20.5                      |
|                |                        |              | 1              | 3.62                                       | 5.01    | 28.0                      |
|                |                        |              | 2              | 1.95                                       | 2.91    | 34.4                      |
| III            | Subcutaneous           | 0.139 †      | 3              | 0.92                                       | 2.0     | 54.8                      |
|                |                        |              | 5              | 0.76                                       | 1.42    | 48.2                      |
|                |                        |              | 24             | Nil  | Trace   | ..                        |

\* Total = Free and conjugated sulphanilamide.

† Dose = 0.1 mg. sulphanilamide.

‡ Dose = 0.5 mg. sulphanilamide (approx.).

### Discussion

From the experimental observations so far made (*vide* tables I and II) it is concluded that the compounds studied are fairly well tolerated. Amongst them, the compound I may be considered to be practically non-toxic—the mice tolerating 6 mg. per gm. given intravenously with slight reaction, and 10 mg. per gm. subcutaneously without any bad effect (Halpern and Mayer, *loc. cit.*). It is interesting to note, however, that the compounds II and IV are much better tolerated when injected subcutaneously than when given intravenously. The lower toxicity in the former case may be due to a slower absorption and subsequent gradual decomposition to its parent compound sulphanilacetamide\* which is found to be less toxic than sulphanilamide. The higher toxicity of this soluble preparation given by intravenous injection may be due to the inherent property of the compound itself, or due to the lower pH of the solution. The compound III, though offering a solution of a higher pH identical with that of I, is more toxic than the latter.

In evaluating the different compounds again on the basis of their power to attain high concentration in the blood, it may be noticed from table III that, although the molar amounts of the different products were injected under identical conditions, the initial rise, the maintenance and the fall of the drug concentrations in the blood were not the same in each case. Another factor which is often found to lower the therapeutic efficacy of a sulphanilamide derivative is the rapidity with which it undergoes conjugation. From all these considerations it would be noticed that the compound I, though not attaining the concentration in the blood of the compound III or of sulphanilamide itself, maintains its concentration and is not acetylated to any high degree. All these characteristics of the compound I along with its lower toxicity point to the usefulness of this drug in any parenteral therapy. The compound III appears to be the next best.

The observations tend to establish the facts that the toxicity of any soluble sulphanilamide derivative may not depend only on the amount of sulphanilamide theoretically recoverable from it, and that equimolecular doses of different compounds do not produce equivalent concentrations in blood in terms of sulphanilamide. The whole problem is intimately associated with the rate of absorption and excretion of the particular compound. The question now arises whether the different compounds, given in such doses as give rise to equal concentration in the blood in terms of sulphanilamide, will be equally effective therapeutically. Work on this subject is already in progress.

(Concluded at foot of next column)

\* Unpublished data.

## INTRAVENOUS ANÆSTHESIA WITH SPECIAL REFERENCE TO THE USE OF THE BARBITURATES

By K. W. LEON

CAPTAIN, R.A.M.C.

### General consideration

THE first successful intravenous anæsthesia produced in man was accomplished by Ore of Lyons in 1872 : for this purpose he used chloral hydrate.

Since that date a variety of drugs has been used for the same reason including the following :—diethyl ether, hedonal, ethyl alcohol, tribromethyl alcohol or avertin, and the rapidly-acting barbiturates.

I propose in this article to deal with the use of the last group but feel that a word or two on the subject of the barbiturates as a whole would not be out of place.

They fall into three main groups :—

1. *Long-acting*.—e.g. allonal, dial, luminal, medinal, trional, and veronal.

2. *Short-acting*.—e.g. sodium amytal, nembutal, pernocton, rectidon, and seconal.

3. *Rapidly-acting*.—e.g. evipan sodium, pentothal sodium, sodium thoethylamyl, eunarcon, and narconumal.

Those in the first group are administered mainly by the oral route, and are used as sedatives or hypnotics, though luminal may be used as a basal narcotic. Those in the second group may be given by the oral or intravenous

(Continued from previous column)

### Conclusion

The disodium salt of  $\gamma$ -phenyl propyl-amino phenyl sulphamide  $\alpha$  :  $\gamma$ -disulphonic acid and the sodium salt of sulphanilacetamide seem to be two useful soluble drugs for parenteral sulphanilamide therapy.

The toxicity of any soluble sulphanilamide derivative seems to be independent of the liberation of sulphanilamide in the system.

The author wishes to express his sincere thanks to Dr. U. P. Basu for his interest in this work.

*Note*.—Compound I appears from its formula to be identical with 'soluseptasine' whose toxicity will certainly have been tested by the manufacturers, and it was probably the low toxicity that led them to choose it for marketing.—EDITOR, I. M. G.

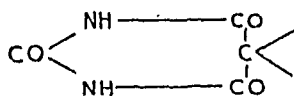
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routes, and are mainly used for the production of basal narcosis. Those in the third group, especially evipan sodium and pentothal sodium, are almost invariably administered by the intravenous method for the production of anaesthesia proper of varying duration.

All the barbiturates have a common chemical grouping



and to this common grouping sodium sulphur or other molecules may be attached. There is thus obtainable a very large variety of drugs. Other therapeutic uses to which these drugs may be put are as sedatives and anti-convulsants in the treatment of chorea and delirium tremens. They are also used for the control of late ether convulsions arising during anaesthesia, and finally they have in recent years been used extensively in psychiatry, a process known as 'narcosis analysis'.

In general the effect of these drugs is variable—so many factors are involved. In a thousand cases, it was found that the most resistant individual required four times the dose of the least resistant.

The barbiturates, however administered, cause some lowering of blood pressure and some respiratory depression. They are excreted by the liver as urea, though the blood-sugar and blood-urea values are little affected during anaesthesia. In gross overdosage agranulocytosis or toxic jaundice may occur. All the barbiturates offer some protection against the toxic effects of cocaine and chloroform.

#### *Indications and contra-indications*

The *indications* for this type of anaesthesia quoted in most textbooks are—

1. Short anaesthesia if  $\text{N}_2\text{O}/\text{O}_2$  is difficult to obtain, especially for operations upon the mouth and face.
2. Anaesthesia where the diathermic cautery is to be employed.
3. Anaesthesia where chronic respiratory disease is present.
4. Ophthalmic operations.

The *contra-indications* usually given are as follows :—

1. Gross impairment of liver or kidney function.
2. Severe cardiac or respiratory embarrassment.
3. Deep cervical sepsis (e.g. quinsy).
4. Asthma.

I would like to put forward a plea for the use of barbiturate anaesthesia in a much wider field than that indicated above, and I feel that this type of anaesthesia has a definite place in the surgical treatment of injuries to-day. In my opinion it is safe to employ this method in operations of any length and severity, provided that a total dosage of 3.5 g. is not exceeded.

This figure refers to pentothal sodium, which is the drug most extensively used in this work.

Continuous pentothal anaesthesia has been used extensively in London recently, notably by Quayle working with Carnac Rivett at the Chelsea Hospital for Women. Every gynaecological operation, including complete Wertheim clearances, has been undertaken successfully.

I myself have employed it for herniorrhaphies, appendicectomies, gun-shot wounds of abdomen and other parts and in some severely shocked patients.

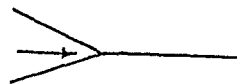
In such cases, provided the technique described below is adhered to, it has given satisfactory if not striking results.

#### *Technique of administration and effects of barbiturate anaesthesia*

Before discussing the actual dosage and methods employed in this form of anaesthesia, I would like to point out that in my opinion *some premedication should invariably be given*, and that each patient should be treated individually.

I think it is true that there is no standard amount of any given drug that will suit every case. There are all kinds of factors involved, e.g. weight, general condition, presence or absence of shock, etc., and the reaction of the patient to any given dose of barbiturate (or any other anaesthetic). For these reasons every case should be assessed on its merits. As a general rule I give omnopon gr. 1/3; scopolamine gr. 1/150 but this can be increased or replaced by a morphine-atropine combination. (In this country I replace the atropine by hyoscine hydrobromide gr. 1/100.) In the selection of a vein, any vein can be used with the exception of the varicose variety: in these stagnation and thrombosis may occur, which are obviously to be avoided.

The common difficulties occurring in intravenous work are transfixation of the vein and excessive mobility of the vein, and the best methods of overcoming these are to use a short bevelled needle and to use the angle of two veins if possible for injections, viz,



There are three methods of administration, the single dose method, the repeated method, and the continuous method. In the first method, sufficient evipan sodium or pentothal sodium is injected, with or without a safety pause, till consciousness is lost—a further few c.cm. are put in and a total of  $\frac{1}{2}$  to 1 g. used in all. This should give an anaesthesia lasting some 5 to 6 minutes and ample time for small surgical procedures to be performed.

In the second method, at least 20 c.cm. of solution are employed, 1 to 1.5 g. of barbiturate being injected in small quantities, the needle being kept in the vein throughout. By

this means a longer anaesthesia of some 10 to 15 minutes is obtained.

In both of these methods, a 5 per cent or 10 per cent solution is employed. In the third method a preliminary  $\frac{1}{2}$  gr. of barbiturate is injected till consciousness is lost. 1 to 2 g. further are now dissolved on 560 c.cm. of either glucosaline plasma or whole blood. This mixture, which results either in a 1/6 per cent or 1/12 per cent solution, is now given by any simple drip apparatus.

I myself use a drip designed by Professor Macintosh of Oxford which was fully described in a recent issue of the *Lancet*, and have succeeded in producing adequate anaesthesia for most surgical operations which will last if necessary up to a period of two hours.

As mentioned above, no more than a total of 3.5 g. of barbiturate should on any account be given.

Induction with these drugs is rapid and pleasant, the patient gradually feeling sleepy, yawning a little and gently passing into unconsciousness. There is occasional twitching with evipan sodium, but with pentothal sodium a very smooth 'fade out' is assured. The blood pressure falls and respiration is depressed. The tongue falls back and an airway is essential. The depth of anaesthesia should be judged by the depth of respiration and by the relaxation of the masseter muscles. The eye signs are unreliable and in my opinion can be ignored.

Recovery is prolonged, and various sequelae have been described, such as excitement, drowsiness, photophobia, headache, nystagmus and bradycardia.

In the many cases in which I have administered pentothal sodium, I have never seen any of these except drowsiness, and only on the rarest of occasions has there been any post-operative vomiting. Overdosage is indicated by intense respiratory and circulatory depression. If this occurs it may be treated by  $\text{CO}_2/\text{O}_2$  mixtures, or the intravenous injection of coramine (5 to 10 c.cm.) or picrotoxin (3 mgm.). Repeated lumbar puncture is also said to assist.

There are one or two further points I would like to make as arguments in favour of this type of anaesthesia.

Firstly, I think it can be said that by using the barbiturates, psychic trauma is reduced to a minimum. It seems to me that whatever the subsequent anaesthetic, induction by this method gives rise to the best results.

All patients with whom I have discussed the question, both in civil and military work, agree that it is a pleasant method. Those who have experienced it have not had any fear of its repetition on subsequent occasions.

A second, and to my mind important, factor is that of portability. Large quantities of barbiturate, and a few syringes and a simple drip apparatus can be conveniently carried in a small space, although for the continuous method,

(Concluded at foot of next column)

## ON PULMO-CIRCULATORY DYSFUNCTION IN LUNG TUBERCULOSIS

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and

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RECENT advances in clinical, radiological and biological investigations have improved the accuracy of diagnosis of pulmonary tuberculosis. The routine examinations by auscultation and percussion and its completion by x-ray examination bring forth numerous findings with respect to the extent of the diseases and the anatomo-pathological conditions of tuberculous patients. Repeated blood examinations (sedimentation test, differential count of white blood cells) yield valuable information. Relatively few reports, however, are available about the influence of tuberculosis on the vital function of the lung, i.e. its respiratory efficiency. As functional examinations are of paramount importance in digestive disturbances, in urinary, nervous and many other diseases, the following discussion will show that the respiratory function also plays no minor rôle in pulmonary tuberculosis.

Before entering the subject of functional examinations of the lung, we have to remember some facts concerning the physiological purpose

(Continued from previous column)

bottles of glucosaline or plasma are necessary. This is an advantage over the carriage of heavy cylinders of  $\text{N}_2\text{O}/\text{O}_2$ , etc., and the accompanying machines: more particularly is it so in this country, where for the moment there appears to be a shortage of the latter articles.

Thirdly, I would like to say that I have been much impressed with the results of continuous barbiturate anaesthesia in patients who were suffering from some degree of shock.

Obviously no patient should be operated upon until resuscitation has taken place. There are, however, occasions in which operations are urgently required at the earliest moment consistent with the patient's safety.

In cases of this type, in which I have used this method, the results have been good. Blood pressure readings have at the most showed a drop of 10 mm. Hg. during the operation. There have been practically no post-operative complications, and very rarely any vomiting or headache; the long 'carry over' produced has also benefited such case, in that it produces a long period of freedom from pain, and lessens to a large degree the need for post-operative morphine.

I should like to thank Colonel Robertson of the 47th British General Hospital for permission to publish this article, and to acknowledge the help I have received in writing it from Dr. Langton Hewers' *Recent Advances in Anaesthesia*.



people. Within certain limits depending on more or less deep ventilation, one may also compare the respiratory exchange on the base of the respiratory quotient  $\frac{\text{CO}_2}{\text{O}_2}$ , the ratio between the volume of  $\text{CO}_2$  output and  $\text{O}_2$  intake. Still more reliable results may be obtained in basing all items upon their ratio with the body surface compared with previously fixed standard values.

The gaseous exchange, in order to be normal, requires a determinate correlation between the circulation and the ventilation. The absorption of oxygen in the blood and the elimination of  $\text{CO}_2$  take place according to the physical laws of gaseous pressure and diffusion. The alveolar air of a healthy person at rest contains a constant percentage of  $\text{CO}_2$  averaging 5.6 per cent. But, as the gases do not act by virtue of their percentage but proportionately to their partial pressure, we state that the alveolar  $\text{CO}_2$  has a pressure from 35 to 45 mm. Hg, average being 40 mm. Hg. In advanced tuberculosis, however, we find insufficiently aerated areas, a stagnation with lowered percentage of alveolar oxygen and accumulated  $\text{CO}_2$  up to 6 per cent corresponding to a pressure of 42 to 43 mm. Hg; in other words, the blood of a tuberculous patient tends to a slight acidosis, compensated by the alkali reserve of the organism. The gaseous pressure in the aveoli is almost equal to that of the blood, which is an important fact, because it permits investigation of the former which is actually easier to do, as an indication of the latter.

The quantity of oxygen in the blood depends on the quantity of hæmoglobin, on the alveolar pressure of oxygen, and on the reaction of oxygen fixation according to the partial pressure of this gas. In fact, oxygen is not completely dissolved in the blood; it is principally combined with the hæmoglobin, changing into oxyhæmoglobin. The saturation of hæmoglobin with oxygen varies mathematically according to the gaseous pressure of the blood, as demonstrated by the dissociation curve of oxygen (figure 1).

What matters is not the quantity of oxygen but the saturation of oxyhæmoglobin irrespective of the quantity of hæmoglobin. The oxygen of alveolar air in a healthy person has a pressure of about 80 to 110 mm. Hg. At this pressure, the saturation of oxyhæmoglobin is about 96 to 98 per cent, the absorption of oxygen being quite small (one may make an individual respire pure oxygen at the same pressure, without the blood becoming more saturated with oxygen than in normal respiration). Below 80 mm. Hg, however, any further decrease of  $\text{O}_2$  pressure causes a considerable decrease of oxyhæmoglobin, so much so that the gas frees itself easily from its combination with hæmoglobin in order to pass into the tissues. On the other hand, any increase above 150 mm. Hg has no influence on the oxygenation of the blood.

Thus, the saturation of oxyhæmoglobin is largely independent of pulmonary ventilation. Increase of  $\text{O}_2$  pressure has but little importance. Decrease causes a marked effect as soon as the pressure drops below 80 mm. Hg.

The pressure of alveolar  $\text{CO}_2$ , however, and consequently that of arterial  $\text{CO}_2$ , depends much on pulmonary ventilation. The carbon dioxide of the blood is partly in solution but predominantly in combination with the salt of the plasma and of the red blood corpuscles in the form of bicarbonate. Thus, the blood may be charged with a much greater quantity of  $\text{CO}_2$  than in an ordinary solution as shown in the following dissociation curve of  $\text{CO}_2$  (figure 2).

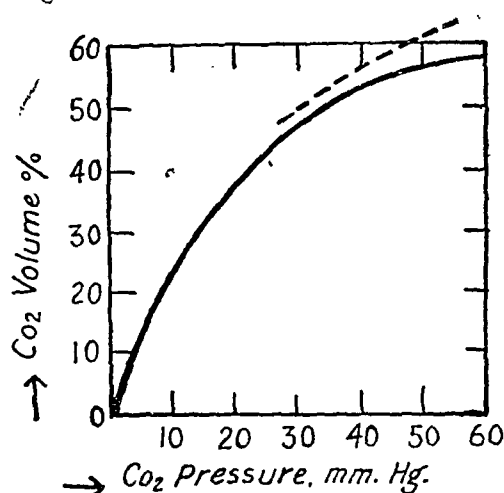


Fig. 2.

The abscissæ show the partial pressures of  $\text{CO}_2$  in the blood and the ordinates the total amount  $\text{CO}_2$ , dissolved and combined ( $\text{H}_2\text{CO}_3 + \text{NaHCO}_3$ ). At the usual alveolar pressure of 40 mm. Hg of  $\text{CO}_2$  the blood contains 51 volume per cent of  $\text{CO}_2$ .

Knowing the quantity of  $\text{CO}_2$  we are able to compute the  $\text{H-ion}$  concentration of the blood and its equivalent, the pH. At an alveolar pressure of 40 mm. Hg of  $\text{CO}_2$ , the pH of normal arterial blood is generally computed to be 7.36, which corresponds to a low alkalinity, the neutral being 7.0.

In tuberculous patients with small and little active lesions (e.g. apical tuberculosis) the blood is saturated with about 97 per cent oxygen and contains about 51.3 volume per cent  $\text{CO}_2$ , being therefore normal.

In extensive tuberculous cases, however, we find higher rates of  $\text{CO}_2$  in the alveolar air and lowered oxygen values than normal. The arterial blood may show a saturation of 93 per cent or 94 per cent of oxyhæmoglobin and about 56 to 57 volumes per cent of  $\text{CO}_2$ . Thus, the alveolar air has a higher partial pressure of  $\text{CO}_2$  than normal, and the arterial blood tends to a slight acidosis, causing the organism to free alkali in order to maintain its pH. In these cases, the dissociation curve of  $\text{CO}_2$  rises higher than normal (as given by the dotted line in figure 2).

These facts show that in little advanced cases the gaseous exchange is practically normal, while in extensive (far advanced) tuberculosis a state of more or less marked acidosis prevails which may be compensated for by increased bicarbonates.

### *Respiratory insufficiency*

There is respiratory insufficiency if (a) the respiration is unable to saturate the blood with the necessary oxygen (anoxia after Van Slyke, or anoxæmia after Bancroft) and to liberate any excess of carbon dioxide; (b) if the acid-base equilibrium is disturbed; (c) if the arterial blood, i.e. the oxygen, is not distributed in accordance to the respective requirements of the tissues. Respiratory insufficiency must not be confused with what we generally call dyspnoea which manifests itself by difficult breathing, the effort of respiration becoming conscious to the subject.

According to Brauer, respiratory insufficiency may be due to—

(1) Central causes (e.g., in poisoning by veronal or morphine).

(2) Aerogenous causes (if the quantity of oxygen in the inspired air or the atmospheric pressure decreases below a certain limit).

(3) Pulmonary causes which are of particular interest to our discussion.

(a) Disturbance of the mechanical act of respiration.

(b) Impairment of the distribution of air or blood.

These conditions (a) and (b) may happen in rigid thorax, emphysema, bronchiectasis, kyphoscoliotic deformity, pulmonary stasis, tubercular cirrhosis, mediastinal displacement, collapse therapy, etc.

(c) Sometimes more or less normally vascularized parts of the lung do not get into contact with air and cannot arterialize the blood. That is what the German school calls 'short-circuit' and may be better defined as *arterio-venous deviation* (or shunt) which we encounter in pneumonia, in other kinds of pulmonary congestion and in atelectasis. Instead of being arterialized, venous blood returns from the affected area; mixed with normally arterialized blood it reduces the percentage of oxygen.

(d) *Pneumonosis* (Brauer) happens in cases of difficult gaseous diffusion of the alveolar air due to pathological alteration of the alveolar epithelium (e.g. in gas poisoning, severe emphysema, general anæsthesia, etc.).

### *Signs of respiratory insufficiency*

It is very important to differentiate between respiratory insufficiency in exercise (dynamic insufficiency) and such in rest (static insufficiency). In both ways, there is respiratory insufficiency if the breathing reserve tends to disappear and becomes insufficient for the arterialization of the blood. Its most evident

manifestation appears if the maximum respiratory capacity is inadequate to deal with increased respiratory needs. It can be recorded through the *ratio between the maximum breathing capacity and the tidal air per minute*, which is in normal conditions about 10:1; a ratio below 2:1, at rest, proves respiratory insufficiency. Thus, a reduced respiratory reserve may bring about an oxygen deficit in the blood and an increased CO<sub>2</sub> content. This anoxæmia combined with increased acidosis becomes the cause of tissue asphyxia.

Another manifestation of respiratory insufficiency is the *peripheral oxygen deficit* which is computed through the difference between O<sub>2</sub> consumption in ordinary respiration of air and that in respiration of pure oxygen. There is respiratory insufficiency if the latter is increased. It appears in some cases with reduced oxygen content in certain peripheral parts of the circulation as if to save oxygen for the supply of more vital parts of the organism, e.g. decrease in the limbs for the benefit of the intestinal circulation in digestion. In very marked peripheral oxygen deficit we may almost always presume some want of oxygen of the cardiac muscle.

Again, a very reliable respiratory test is the *apnoic interval* breath holding which gives a good indication of the combined respiratory and circulatory efficiency. Normally, a person can hold the breath for about 50 to 70 seconds, but in cases of pulmo-circulatory deficiency hardly 15 to 20 seconds.

The circulatory function, which is in close correlation with respiration, can be tested by the cardiac output per minute at rest as well at exercise. It is the quantity of blood which the heart is able to put into circulation per minute. The normal average at rest amounts to 4 or 5 litres, increasing with exercise up to 30 litres. The maximum amount of oxygen thus transported in exercise may be 2 to 3 litres in healthy people, beginning with about 200 c.cm. in rest. In cardiac or pulmonary affections the maximum transport of oxygen may possibly remain below 1,000 c.cm. Knowing the amount of oxygen which the blood receives per minute through the alveolar exchange, the ratio between this value and the amount of oxygen distributed in the organism at the same time gives the amount of blood passing through the lungs per minute. After withdrawal of a specimen of arterial blood, the saturation of arterial oxygen is found by gas analysis.

The test of cardiac efficiency is completed by taking an *electrocardiogram*, again at rest and exercise. The causes of alterations in the three usual leads are usually classified in three groups:—

(1) Acute toxic effects with functional disturbances.

(2) Chronic toxic alterations which correspond generally to manifestations as seen in myocardial affections.

(3) Mechanical effects of the pulmonary tissues upon the heart and mediastinum. The knowledge especially of the last group is very important in tuberculosis as they should not prevent collapse therapy in otherwise suitable cases.

Often lung tuberculosis brings about some degree of deficiency of the right heart generally not to be seen in the electrocardiogram. Gradually, however, the deficiency spreads into the left ventricle causing, in the long run, a lowered voltage in all three leads. There is cardiac insufficiency if the voltage drops below 0.2 millivolt.

Recent experience has shown that many cases of post-operative collapse are due to sudden failure of the peripheral circulation which cannot be predicted from an ordinary electrocardiogram. Examinations in this respect by direct leads from the heart in exercise (Schlomka) revealed however some particular aspect of the T-wave. There are two types of T-wave reaction to exercise. The first group shows a small decrease with following increase and short recovery period. The second group shows delayed reaction and recovery and especially a primary increase which lasts rather long before returning to the normal. If this second type of reaction occurs in lung tuberculosis, its particular feature is much more accentuated, viz, a very high T-wave sometimes persisting up to half an hour before returning to the normal. It seems that this phenomenon is less due to the heart muscle itself than to individual causes in cases of vegetative-neurotic lability (vagotonic and sympathicotonic reactions). We find similar phenomena in vasoneurotic, hypertonic and thyreotoxic conditions.

Thus, the differentiation between cardiac and vasoneurotic disturbances of the circulation may become very useful with respect to timely interventions in precarious pre- or post-operative conditions.

#### Functional examination

From the above-mentioned discussion it will be seen that the functional examination should on principle be carried out twice, at rest and after exercise. Careful precautions are very important. Maximal breathing and cardiac capacity should never be overstepped lest the patient may incur some strain with aggravation of symptoms.

Generally, any apparatus for measuring the metabolic rate will do. The apparatus introduced by Knipping (figure 3) has shown many advantages: The patient is breathing through a closed system of circulating gas (air or  $O_2$ ). From the mouthpiece or breathing mask the gas is passing into the spirometer proper, a bell floating in a water-filled tank, the weight of the bell being counterbalanced by a counterpoise. The spirometer, of course, is filled beforehand with gas through a special pipe of supply. From the spirometer the gas continues its way through

an electric air pump driving the gas continually through the whole system in order to overcome any resistance or dead space disturbance. From there, the gas has to pass through a solution of soda-lime which absorbs all  $CO_2$ . The carbon dioxide may be liberated again by adding  $HCl$  which is kept ready for use on the top of the soda-lime bottle. In breathing, the bell of the spirometer will move up and down, the movements being recorded upon a kymograph driven by clock-work. The record of the kymographic chart shows the volume of ventilated gas in c.c. by its ordinates and the time in minutes by its abscissæ.

The spirometer records all necessary respiratory values mentioned above, except the residual air which is measured by the 'closed rebreathing circuit' method. The results should be collected for practical purposes on a special chart (table II) and compared with the calculated values in each individual case based on square metres of the body surface.

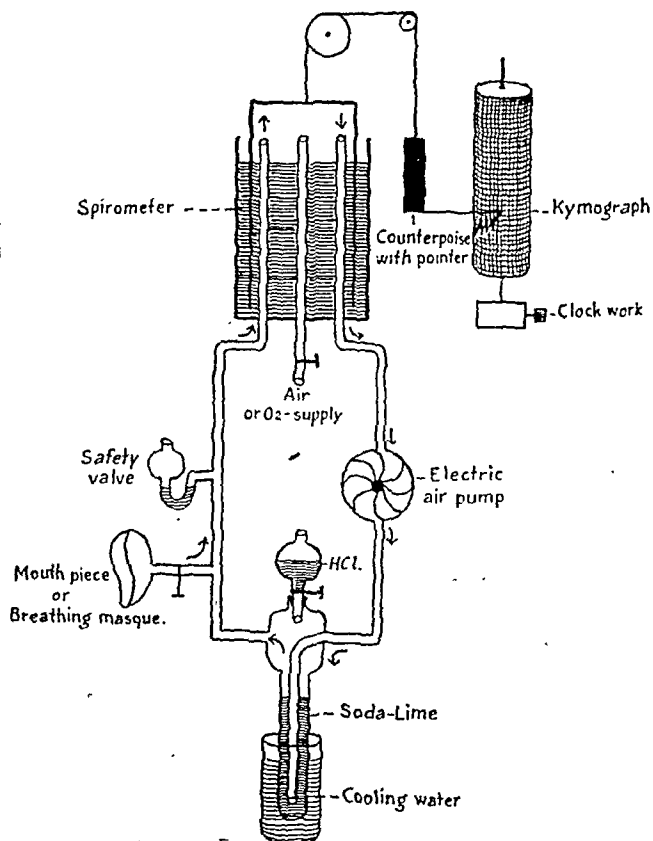


Fig. 3.

#### Dysfunction in tuberculosis

##### A. In parenchymatous changes.

In dealing with pulmonary tuberculosis we are used to think first and foremost of its anatomical aspect with its clinical, radiological and serological manifestations. We think less of toxic influences on the organism and bother but little about its 'blocking' action upon the respiratory and circulatory system, and the physiological repercussion of the mere presence of the lesions.



TABLE II

|  | Computed value                          | Recorded value | DIFFERENCE IN % |          |
|--|---|----------------|-----------------|----------|
|  |   |                | Decrease        | Increase |
| Basal metabolic rate ..                        |   |                |                 |          |
| Complemental air ..                            | 2,000                                   |                |                 |          |
| Supplemental air ..                            | 700                                     |                |                 |          |
| Tidal air ..                                   | 350                                     |                |                 |          |
| Vital capacity ..                              | 3,000                                   |                |                 |          |
| Residual air ..                                | 800-1,000                               |                |                 |          |
| Total capacity ..                              | 4,000                                   |                |                 |          |
| Residual air<br>Total capacity $\times 100$ .. | $\frac{1,000}{4,000} \times 100 = 25\%$ |                |                 |          |
| Respiratory rate ..                            | 15-18                                   |                |                 |          |
| Tidal air per minute ..                        | 8-10,000                                |                |                 |          |
| Oxygen consumption per minute.                 | 200-300                                 |                |                 |          |
| Respiratory equivalent                         | 1.8-3.7                                 |                |                 |          |
| Max. breathing capacity                        | 100,000                                 |                |                 |          |
| Breathing reserve ..                           | 90,000                                  |                |                 |          |
| Max. breathing capacity                        | $\frac{100,000}{10,000} = 10$           |                |                 |          |
| Tidal air per minute                           | $\frac{10,000}{1} = 1$                  |                |                 |          |
| Peripheral oxygen deficit                      |   |                |                 |          |
| Apnoic interval ..                             | 50"-70"                                 |                |                 |          |
| Recovery after exercise                        | 5'                                      |                |                 |          |

The influence of tuberculosis on pulmonary function may be toxic (indirect) or local (direct). If, up to the present time, little has been known about the toxic influences on the organism, it is because their nature is difficult to grasp and to define. Considering, however, that the toxic reaction may easily influence the regulatory centres of respiration and circulation, we may expect to get some useful information by studying the respiratory and circulatory efficiency. (It is known, *e.g.*, that an ordinary 'cold' may decrease the maximum breathing capacity in exercise up to one-tenth of its due.) The influence of the tuberculo-toxin on the heart has long been observed, so much so that one expects that every case of tuberculosis of long duration always shows some toxic alteration of the myocardium. The rest of the circulatory system seems to be less involved or at least less manifestly so, though the peripheral circulation and its central regulation play no minor

part in the transportation of oxygen. Again, the oxygenation of the blood is the result of the respiratory and circulatory concert; frequently we encounter a toxic tachycardia causing some degree of oxygen deficit with subsequent alteration of the pulmonary and general circulation while, on the other hand, the venous congestion may slow down the pulse rate for a certain time. Sometimes there is a circulatory stasis in the peripheral regions; sometimes, as in caseous pneumonia, there is a circulatory stasis in the lungs. Thus, it may happen that we try to stimulate the circulation by bleeding, mustard plasters, cardiac analeptics, etc., without knowing for certain whether the stimulative effect may not cause another and perhaps more serious congestion. A short functional examination and an electrocardiogram enable us to elucidate many doubtful conditions and to guide our therapeutic indications.

Direct or local influences of pulmonary tuberculosis depend on various causes. Impairment of circulation varies with the extent of the lesions and the consequent resistance to the circulation which are caused by infiltration, cicatrization, local or general emphysema, atelectasis, miliary sclerosis, etc. In the long run, hypertrophy of the right heart appears, and finally symptoms of cardiac insufficiency, *viz.*, venous congestion, increased venous pressure, cyanosis, dyspnoea, etc. In these conditions, there will always be a more marked impairment of the maximal cardiac output than of the cardiac output at rest.

Numerous examinations have shown that a deficit in arterialization does not happen as frequently in lobar pneumonias or other dense infiltrations as was formerly believed. The deficit by arterio-venous deviation (blood shunt) again is less important than was previously thought. The most marked want of saturation happens rather in stasis and pulmonary oedema, in broncho-pneumonias and in cardiac decompensations with hypoventilation. These are the cases where oxygen application has its most striking effect, because the deficit of oxygen saturation cannot be compensated by artificial stimulation of the heart output and no nervous impulse can help to induce any hyperventilation.

In emphysema the dead space and consequently also the residual air are very great, but the impairment of arterial saturation is not as evident as might be expected in these large but badly aerated areas, provided that the maximum breathing capacity is not too much decreased. The reason for this observation may be seen in the reduced pulmonary circulation and in the fact that the reduced  $O_2$  tension still allows a quite sufficient arterialization. These rules, however, do not apply to cases with already rigid emphysema.

Thus, cases of emphysema with or without rigidity may show more or less satisfactory

results in functional examinations while in rest. The problem of dysfunction in exercise, however, is of utmost importance. The least effort may cause a sudden manifestation of failing respiratory reserves and incomplete arterialization. A case of combined emphysema and scattered fibrosis has been recently recorded by Cournand and Richards, which shows a narrow margin of safety with precipitation of acute respiratory insufficiency when the small part of remaining normal lung tissue was encroached upon by induction of an artificial pneumothorax. The resulting intensity of dyspnoea and anoxaemia could be strikingly controlled by oxygen application. The functional examination revealed a marked degree of ventilatory insufficiency due to advanced emphysema, the residual air being 64 per cent of the total lung volume, the maximum breathing capacity only 32 litres per minute.

If, simultaneously, there is a more or less marked decompensation of the cardiovascular system, these cases rapidly manifest complete insufficiency of oxygenation. On the other hand, if there is circulatory insufficiency with more or less normal respiratory values, we have to expect a miliary form of sclerosis rather than emphysema.

#### B. In collapse therapy.

At present, functional examinations are mostly carried out preliminary to collapse therapy in order to define its indications and to check partial or definite results. It is most important to know the limit of suitable collapse and the decrease of respiratory function still compatible with a minimum capacity of work.

Dyspnoea, being subjective and variable, does not give sufficient information, nor does cyanosis appearing only when stasis is already present. The best criterion is the oxygen saturation of the blood. An arterial deficit at rest prohibits any operation whatever, whereas intervention may be possible so long as the oxygenation of the blood is sufficient.

The ideal is to secure a collapse which allows still complete arterialization in daily average exercise. In overstepping this limit we neglect the main purpose of collapse therapy, *viz.*, to obtain rest for the affected lung; ventilation would be increased by oxygen deficit; the acid-base equilibrium being disturbed, the whole organism would become deficient.

*Effusion.*—A large effusion always favours a respiratory deficit.

*Pneumothorax.*—We have dealt already with the fact that in extensive tuberculous lesions the affected part of the lung is insufficiently aerated, showing a stagnation of alveolar air with decrease of oxygen and increase of carbon dioxide. Suppose the other lung to be normal, yet it is unable to interfere with the defective respiration of the affected side. The mixed arterial blood coming from both lungs has therefore a subnormal saturation. This saturation of oxyhaemoglobin decreases consequently

to 92 per cent or 93 per cent (the normal being 97 per cent). After induction of a pneumothorax, the deficient blood flow from the affected area will be mostly suppressed. The blood now arising predominantly from the healthy lung is perfectly saturated. Already after a few insufflations, the oxyhaemoglobin value may rise again to 96 per cent and simultaneously the volume percentage of CO<sub>2</sub> may return to its normal rate.

Sometimes we are struck by an apparently paradoxical phenomenon in unilateral cases, *viz.*, disappearance of dyspnoea after induction of pneumothorax. As we know that anoxaemia affects the respiratory centre causing hyperventilation, our above-mentioned exposition demonstrates that by suppressing this anoxaemia we may be able to obviate hyperventilation and dyspnoea.

The effect of a *bilateral pneumothorax* on the respiratory equilibrium is less disturbing than the same total amount of air given into one side. Thus, 500 c.cm. filled into each side may be devoid of any effect on the alveolar pressure, whereas 1,000 c.cm. filled into one side may cause a very marked disturbance. The more an AP filling is increased, the more arterial oxygen pressure and blood circulation will decrease, additionally driving to rapid decompensation. The resulting anoxaemia causes hyperventilation (with or without dyspnoea) and counteracts the therapeutic purpose. The functional examination will serve as a reliable test for the margin of sufficient arterialization.

*Thoracoplasty.*—What has been said about pneumothorax treatment applies still more to thoracic operations. While the method of Forlanini allows a certain elasticity of physiological factors, capable of being controlled and directed by the physician, plastic operations will always result in a rigid and irrevocable collapse of the whole lung or part of it. Thoracoplasty, whether complete or partial, leads principally to a decrease of functional capacity. It has been observed, however, that even with improved method of selection of cases most of the suitable cases always show some respiratory or circulatory impairment before the operation and also that with improved operative technique, the increase in impairment was less than the extent of the operation led one to expect. As we saw in pneumothorax treatment, the suppression of the breathing of the affected lung allows a renewed equilibrium of the physiological condition.

A markedly beneficial effect on the cardio-pulmonary function may be obtained by thoracoplasty in cases which need this operation in order to replace an ineffective pneumothorax or still more a phrenic interruption. According to Cournand and Richards, a marked degree of ventilatory, respiratory and circulatory dysfunction existed in such cases before thoracoplasty, most of which are significantly improved, the patient's physical capacity being greater after

completion of thoracoplasty. Similar observations of benefit from thoracoplasty were made in cases with long-standing empyema or with fibrothorax or thickening pleurisy.

*Phrenic interruption.*—Although the diaphragmatic paralysis frequently produces striking anatomical improvement and is easy to do and causes little or no operative shock, it gives the worst functional results of all collapse procedures. Cournand and Richards found impairment of function evidenced by low ratio of breathing reserve to maximum breathing capacity at rest, and also oxygen unsaturation of arterial blood at rest or after exercise. There is a distinct tendency to pulmonary congestion. Phrenicoparalysed cases are seen, indeed, to become more rapidly dyspnoeic at the least exertion than others with bilateral pneumothorax or extensive thoracoplasty.

*Extrapleural pneumothorax* (Graf, Schmidt).—If for any reason ordinary AP treatment is not practicable, extrapleural pneumothorax is the least mutilating and most elastic operation in collapse therapy. The idea behind the introduction and development of this operation has been to produce the best collapse with the least functional impairment. Functional examinations show that this object has largely been attained. According to Gaubatz, the functional impairment seen after extrapleural pneumolysis is remarkably less than, sometimes only half, that seen after apical or other partial thoracoplasties of corresponding extent.

In estimating immediate surgical risk and ultimate physical capacity, any dysfunction on exercise is much more important than at rest. As the present discussion shows, such dysfunctions happen if the breathing reserve is reduced by extensive tuberculous lesions or by excessive emphysema in long-standing fibrotic-cavernous diseases. The patient's physiological output in exercise consequently fails much more rapidly than in health, although all signs of insufficiency may be absent at rest. Serious deficiency is present if the maximum breathing capacity on exercise is reduced more than 60 per cent. Again, the time needed for recovering after exercise is much more significant than the immediate effect. In tubercular patients the recovery may last more than 30 minutes compared with 3 to 5 minutes in healthy persons. The duration of recovery depends on the amount of oxygen deficit after exercise and on the time needed to compensate it.

Generally, it may be stated that unsatisfactory results in surgery may be predicted—

- (1) in reduced breathing reserve of less than 85 per cent of the maximum breathing capacity;
- (2) in arterial oxygen unsaturation at rest or after exercise;
- (3) in high peripheral oxygen deficit;
- (4) in increased ventilatory equivalent above 3.6; and

(Concluded at foot of next column).

## AN INVESTIGATION INTO THE INCIDENCE AND TYPE OF TUBERCULOUS INFECTION IN CATTLE AT AMRITSAR WITH SPECIAL REFERENCE TO HUMAN INFECTIONS

By S. M. MALLICK

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THE idea of bovine infections being transmitted to human beings was first advanced by Theobald Smith (1896) on his finding this type of bacillus in the cervical glands of a child. Searching investigations of this matter have since then been carried out by numerous workers including Robert Koch and the necessary precautions to safeguard the milk were taken in many countries. In India enquiries on similar lines were carried out by Nield (1902), Wilkinson, Joshi and Gloster (1914) and Taylor (1918). The details have been examined by Glen Leston and Soparkar (1917), who concluded that the cattle infection with tubercle bacillus in India was lower than in the west.

Sheth (1921) carried out investigations at Muktesar and typed the strains of bacilli isolated from the specimens collected by Taylor at Ferozepur slaughter house, and advanced his view of the low toxicity and virulence of the various strains of tubercle bacilli affecting the

(Continued from previous column)

- (5) in myocardial damage as revealed by the electrocardiogram.

### Conclusion

Diagnosis, prognosis and indications for collapse therapy can be precisely determined by adding functional examinations to our current clinical, biological and radiological investigations. By these examinations, our useful anatomical and biological knowledge will be much increased. The time is near when our diagnosis, hitherto expressed in anatomical and biological terms, will be completed in those of functional capacity.

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cattle in India, the infection being restricted to a few glands, usually calcified. Taylor himself made a systematic examination of over 6,000 selected cattle slaughtered at Ferozepur and recorded about 3.5 per cent being affected with tuberculosis, of which over 2 per cent showed tubercle bacilli in the lesions. Later in 1927 Soparkar, Edward and Krishnamurti studied the problem again, and on experimental results agreed that the low incidence of clinical tuberculosis in Indian cattle is due to their usual mode of open air living, rather than any question of immunity or resistance in them, or the low virulence of the causative bacillus. Recently in 1931, Soparkar stated in an abstract of paper presented by him at the Indian Science Congress held at Nagpur, that out of 1,116 animals examined by him at the Lahore slaughter house, 225 or 22.85 per cent were found to be infected with tuberculosis and tubercle bacilli were detected in the smears of some, exclusive of others found to be infected on animal tests. The cows showed a lower incidence (21.3 per cent) than buffaloes (23.6 per cent to 31 per cent). No information was however given by him with regard to the type of bacilli found.

We made the study of this problem, by trying to find out the type of bacillus responsible for the infection of extra-pulmonary lesions of the local populace. Strains of bacilli were isolated and typed from the variety of pathological materials received from various hospitals in the Punjab. We observed that out of a series of 62 successfully isolated strains of tubercle bacilli, not a single one was found to belong to the bovine type. An investigation on similar lines had been carried out by Ukil (1933), wherein he did not find a single bovine type of bacillus, out of a series of 60 cases of glandular and osteo-articular lesions. Soparkar (1929) mentioned a similar investigation conducted by him, in a paper read by him at the Indian Science Congress held at Madras. He dealt with 65 cases out of which 40 were of cervical adenitis, 8 of axillary gland tuberculosis, and 17 of pulmonary tuberculosis. None of the above cultures obtained was found to be of the bovine type. It was only at the close of his investigation that he discovered a bovine type of bacillus in a child suffering from cervical adenitis, which was the first case described in India.

The failure to find the bovine type of bacillus in lesions expected to yield it, stimulated further interest in the subject and efforts were made to find out what part, if any, was played by bovines in the transmission of infection to human beings by contact with cattle or by the consumption of milk.

It was thus planned to find out first, the amount of infection in bovines, by carrying out a tuberculin survey with tuberculin obtained from the Imperial Veterinary Research Institute at Muktesar. We started with the eastern side of Amritsar city, our chief areas of operation

being division 7 and division 9 of the city. All the herd and the individual cattle of these divisions were subjected to the double intradermal test.

Once the positive reactors were detected, it was our aim to investigate them further for the presence of tubercle bacilli in their milk. The individual animals belonging to the herd under test were seen a day prior to the inoculations, and a clinical examination was made of their general health. Notes were always kept for any special signs such as emaciation, cough, diarrhoea, rise in temperature, enlarged glands, swollen udder or any other lesion suggestive of tuberculous disease. It is of interest to note here that mastitis, recognized to be the stage of the disease when tubercle bacilli are passed freely in milk, has been met with in only two cows which, surprisingly however, did not reveal any bacilli in their milk on repeated examinations. In one of these animals, a sero-sanguinous discharge was made to ooze out on squeezing the udder. Cattle have however been seen showing extreme emaciation and enlarged glands and having a chronic cough or a chronic diarrhoea.

The injections were given intradermally in two divided doses of 0.1 c.cm. each, of the concentrated tuberculin, the first or the sensitizing dose being followed by the second or the testing dose of the same quantity after 48 hours.

#### *Technique of injections*

A four-inch-square area of the skin, on the side and in about the middle of the neck, was washed with soap and water and shaved preferably a day prior to the inoculations. Recently British workers have preferred to give injections under the skin of the caudal fold to avoid shaving (*Tubercule*, 1938, vol. 8, 347), but we preferred to stick to the side of the neck, on account of greater convenience. The fold of the shaven skin was firmly held in the jaws of a callipers with a sliding scale, to find out the normal thickness of the animal's skin.

On the following day the part was rubbed with an alcoholic disinfectant and pinched up firmly with the left hand. The injection was then given in the tightly drawn layers of the skin. A broad handled dental syringe of 2 c.cm. capacity, with the barrel marked into divisions of 0.5 c.cm., was employed for the purpose. A fine sharp but short needle fixed to the syringe was pushed in the skin parallel to the surface and just when the eye of the needle had gone under the skin 0.1 c.cm. of tuberculin was pushed in, sometimes requiring a good deal of pressure. A bleb-like elevation of the epidermis about the size of a pea was raised, if the injection was properly done. The depth to which the needle should go under the skin depends upon the normal thickness of the latter. Injections accidentally given deeper into the subcutaneous tissue, elicited a very severe local response, which is not significant. The second or the testing dose was given at the same site and in

exactly the same manner as the sensitizing dose, after an interval of 48 hours.

It has been advocated by some writers that the second dose need not be given to the animals showing a marked reaction to the first dose, but in the present series we gave the second dose in every case for the sake of uniformity of the results.

### *Reading of the results*

The measurements of the fold were taken 40 hours after the first and 24 hours after the second dose, the ultimate results being based on the latter reading. Other factors indicating a positive reaction were local heat, tenderness and œdema. These were always found to accompany a reaction producing an increase of more than 10 mm. to the original measurement of the fold. Without these factors being present, the result was not regarded as positive, except when the measurement showed an increase of at least 30 mm. No marked general reactions have been noted, except that the milch cattle showed a definite decrease in the quantity of their output of milk on the day following the injection, a phenomenon with no explanation.

In cases showing a positive reaction, a classification was made based upon the degree of response elicited, in the following manner :—

| The difference between the original and the final reading of the fold | Class of reactor |
|---|------------------|
| (a) Less than 10 mm. ..   | Negative         |
| (b) Between 10 mm. to 30 mm. ..                                       | One plus         |
| (c) Between 30 mm. to 50 mm. ..                                       | Two plus         |
| (d) Between 50 mm. to 70 mm. or above. ..                             | Three plus       |

In all 1,234 animals were subjected to the test, 282 of which exhibited positive reactions of one degree or another, as follows :—

|                            |       |
|----------------------------|-------|
| Plus one reactors .. ..    | 141   |
| Plus two reactors .. ..    | 87    |
| Plus three reactors .. ..  | 54    |
|                            | 282   |
| Negative reactors .. ..    | 935   |
|                            | 1,217 |
| Sold during the test .. .. | 17    |
| TOTAL ..                   | 1,234 |

It has been further observed that buffaloes showed a higher incidence and a greater intensity of reaction than cows.

So intense has been the response in some of the buffaloes that an increase of more than 120 mm. was obtained to the original measurement of the fold in about three cases.

All the animals that were tested, were further divided into certain age groups, to find out the

frequency of infection in different spans of life, which is represented in the following table :—

| Age groups in years          | Total number tested | Positives | Percentage |
|------------------------------|---------------------|-----------|------------|
| One to three years ..        | 165                 | 24        | 14.5       |
| Three to six years ..        | 263                 | 40        | 15.2       |
| Six to nine years ..         | 368                 | 98        | 26.6       |
| Nine to twelve years ..      | 234                 | 65        | 27.8       |
| Twelve to fifteen years ..   | 49                  | 17        | 34.7       |
| Fifteen to eighteen years .. | 12                  | 5         | 41.6       |
| Eighteen to above ..         | 6                   | 3         | 50.0       |
| Unknown age ..               | 120                 | 30        | 25.0       |
|                              | 1,217               | 282       |            |

It will be noticed that the amount of infection increases with age in cattle as in man, in India, in contrast to that in human beings in which a steady decline is reported after early adult life.\*

### *Problem of milk*

After having found a positive reactor, our further aim had been to proceed with the study of its milk. Samples of milk were collected aseptically, and subjected to microscopical, cultural and biological tests, to find out the presence of tubercle bacilli in them.

### *Method of collection of milk*

Four wide-mouthed sterile test-tubes, which had been plugged with sterile cotton, were taken and about 10 to 15 c.cm. of milk from each quarter of the udder milked into each tube. The upper portion of the tube heated on a spirit lamp flame, and the plug of cotton inserted again after having been flamed. The udder and the hands of the milker were thoroughly washed with soap and water before milking. It has been always preferred to have the specimen of the residual milk, known as strippings. After the tubes had been plugged they were placed in a brass holder and carried to the laboratory.

### *Treatment in the laboratory*

Here the tubes of milk were placed in an electric centrifuge and rotated at 2,500 r.p.m. for 5 to 10 minutes, which would separate the milk in three layers.

(a) The top layer of the cream, with a few bacteria.

(b) The middle layer of clear bluish white fluid.

(c) The bottom layer of suspended particles and the majority of bacteria.

### *Microscopic examination*

A little of the top cream was spread on the slide by means of a platinum loop, after which

\* Available data in India and elsewhere are not in agreement with the author's statement. As a rule, the incidence of infection increases with age in man, as has also been noticed in cattle.—EDITOR, I. M. G.

the cream was separated by a small metal spoon, which had been passed through the flame. The remaining portion of the milk was decanted to about half an inch of the bottom by means of a wide-bored pipette. A drop of the deposit that had been left was transferred to a clean slide by means of a capillary pipette. A new glass slide was then placed at an angle to the drop and a film made by drawing the slide from one end to the other. The slides thus made were allowed to dry in the air for at least half an hour and then fixed, defatted with ether and alcohol, and stained by the Zeihl Neelsen method.

In our series of experiments on 101 specimens of milk, we examined about 500 slides in the above manner, but were unable to find out the particular octahedral cell groups. Under the 1/12 objective the usual finding met with have been the cellular debris, believed to be leucocytic or alveolar in origin. Bacteria that have sometimes been seen, belong to the cocci group in chains or clumps, or the aerogenous bacilli. *Mycobacterium tuberculosis* was not found in any of the slides.

#### *Biological testing*

Two guinea-pigs were inoculated for each specimen of milk. The deposit from the bottom of the tube was drawn into a sterile syringe and inoculated in the muscles of the right thigh of the pig in quantities of 5 to 7 c.cm. The inguinal glands on the side of inoculation were rubbed a little before and after the inoculation to cause them a little injury, to facilitate the development of infection in them. The animals were then caged and examined at weekly intervals for any signs of developing tuberculosis. The glands on the inoculated side were carefully palpated on each examination, to find out enlargement of tenderness in them. After 3 weeks one of the animals was sacrificed, to study its viscera, for the progress of the disease, the second one being kept for further observation till 6 to 8 weeks and ultimately sacrificed.

About 48 hours before killing an animal, an injection of 10 c.cm. of old tuberculin was made subcutaneously, to find out if there was a reaction, in case the infection had successfully occurred or, in case the death of the animal took place, if the disease was in active progress (Joseph Race).

It has been observed that animals reacting negatively to the inoculation never revealed any lesions when subsequently post-mortemed. Hence in the latter part of this series of experiments, we did not destroy the animals that had reacted negatively to the tuberculin inoculation and had survived it.

In all about 70 animals were subjected to the tests, out of which 8 died of inter-current infections. Forty-six were inoculated and later on autopsied.\* Sixteen were inoculated without any reaction being elicited.

\*The results of autopsy have not been given.—  
ERROR, J. M. G.

#### *Cultural tests*

To the deposit in the tubes an equal quantity of sterile solution of 15 per cent hydrochloric acid was added, and the tubes shaken vigorously. A few drops of the sterile litmus solution were also added as an indicator. A flamed cotton plug was then applied to the mouth of the tube, which was then kept at 37°C. in an incubator for a period of not less than half an hour to dissolve the suspended particles and the cellular debris. The tube was then taken out and the product titrated with a sterile solution of 15 per cent NaOH till the neutral point was reached, as indicated by the litmus indicator. About 3 to 5 c.cm. of this product were now pipetted on the slopes of the artificial culture media (Lowenstein's or Petroff's), the tubes of media plugged with flamed cotton and placed in the incubator in a slanting position for a day or two to allow an intimate contact with the inseminated product. After the material had dried the tubes were put in the vertical position and a hole bored through the cotton plug, to allow oxygen to the growing bacillus. An examination of the tubes was made every 5 to 6 days. None of the tubes in this series of experiments showed a growth of tubercle bacillus.

#### *Discussion*

From the above it has been observed that, whereas the infection in cattle is quite common, the milk has shown markedly negative results, with regard to the presence of tubercle bacillus in it. The question arises as to why it should be so? If cases of surgical tuberculosis are quite commonly met with here as in the European countries, as was suggested by Major-General Hutchinson, at the second all-India veterinary conference held at Calcutta, the question arises what can be the actual source of such infection, if the agency of milk so far held to be a chief factor in the causation of the disease is altogether ruled out? Bradfield (1925) in a paper in the *Indian Medical Gazette* draws attention to this form of disease as met with in Madras, where the surgical form of tuberculosis comprised 2.1 per cent total admissions in 1924. We have been in communication with the veterinary research workers, and wrote to J. R. Haddow and J. F. Shirlaw, of the Imperial Veterinary Research Institute, Muktesar, on the negative findings of our results, and they were kind to let us know in return, that attempts had been made by them to find out tubercle bacilli from the milk of 22 cases of suspected tubercular mastitis during the last four years with unsuccessful results. It therefore seems that the disease in the cattle so far as this country is concerned takes a very mild course, confining itself to a few glands as stated by workers like Soparker (1925), and the infection of the udder, which is likely to contaminate milk, is rarely reached. The experiments of the Royal Commission on Tuberculosis show that a dose of 50 mg. of culture of bovine origin given subcutaneously is



almost invariably fatal to the English cattle and, with rare exceptions, produces a generalized tuberculosis of a very severe type, which proves rapidly fatal. A certain proportion of Indian calves equally small in size remain well after similar infection, and when autopsied show slight or minimal lesions, indicating that they are possessed of very high power of resistance to tuberculosis as compared to the English calves' (*Indian Journal of Medical Research*, 1923-26, page 765).

This power of resistance in the Indian cattle, accompanied with the open-air mode of living of these animals, serves to restrict the course of the disease. Hence very few cattle reach a stage when they can infect human beings by contact, or when their milk is teeming with tubercle bacilli. It therefore seems that if a case does happen, in whose lesions the presence of bovine type of bacillus is demonstrated, the bacilli behave in a manner entirely 'zoogenic' and not 'anthropogenic' (Kolle and Hetsch, 1934) and hence the infection persists with that particular case, ultimately perishing with the death of the host. Apart from the above, it has been observed that the actual transmission of the disease took place, only if heavily contaminated milk is consumed for a long period of time.

According to Kossel, investigations made from 1905 to 1909 by the Imperial Sanitary Office in Germany show that 151 children and 200 adults had regularly consumed for a longer or shorter period raw milk from cows seen to have tuberculous lesion of the udder. Only two individuals (and they were very young and belonging to different families) were found to have tuberculous glands of a benign form. In both the cases the cow had a very severe form of mastitis involving the whole gland. The other individuals remained quite healthy. It was thus concluded by Weber, who published this account, that infection could only be produced, with repeated ingestion of considerable quantities of bovine bacilli. In New York City Alfred F. Hess followed for three years 18 cases of children who drank milk in which tubercle bacilli were demonstrated, and found that all but one remained free from tuberculous disease (Fishberg).

It therefore appears that the dangers of milk infection have been overestimated by many writers, when considered in the light of the above facts.

It is further reasoned that if animal tuberculosis were causally connected with the origin and spread of human disease, primary tuberculosis of the intestine would, as Koch pointed out, be a much more frequent disease, especially in large towns where tuberculous milk and butter are used in enormous amounts. Referring to the countries where bovine tuberculosis is practically non-existent or where cow's milk is not used in feeding children, e.g. Greenland, we find that the morbidity rate especially of the abdominal type of tuberculosis is not less.

Apart from the above, the usual practice of boiling the milk before consumption is an additional safeguard against the disease in this country.

It therefore appears that the cases of surgical tuberculosis are evolved through human infection of man to man by the human type of bacillus.

If further research in the problem be taken up, and strains of tubercle bacilli be isolated and typed from the bovine lesions, there is a likelihood, that the causative type may be found to be the human type of bacillus, that has been unsuccessful in causing a generalized infection.

#### Summary and conclusions

1. That about 25 per cent of the 1,234 cattle tested were tuberculous as demonstrated by the double intradermal tuberculin test.
2. That the buffaloes reacted rather strongly to the same amount of tuberculin as compared with cows and showed a higher percentage of infection.
3. That the incidence of infection increases with the age of the cattle.
4. That 101 specimens of milk taken from positive reactors were found to be negative for tubercle bacilli, when investigated microscopically, culturally and by animal inoculation tests.
5. That it is not necessary to boil the milk before use to guard against tuberculous infection, though that would be a good preventive against brucella infections and lapses in sanitary precautions.

#### Acknowledgments

We are indebted to Professor G. S. Wilson of the London School of Hygiene for his kind suggestions in the initial arrangements of this enquiry. To H. R. Haddow and J. F. Shirlaw, of the Imperial Veterinary Research Institute, Muktesar, and to Professor A. C. Aggarwal, of the Punjab Veterinary College, for their kind help in giving us the information of the details of animal tuberculosis in India, and suggesting many works on the same. Our thanks are also due to Dr. Nazir Sadique, of the veterinary dispensary, Chatiwind Gate, for his assistance in the conduct of the survey in the beginning, and to Dr. Baldev Raj, in-charge Veterinary Hospital, Hathi Gate, for supplying us with the specimens of milk from suspected cases of mammary tuberculosis. We should also express our gratitude to G. Durrant, superintendent of police, and Dr. S. Rozden, medical officer of health, Amritsar, for the departmental aid that they rendered facilitating this work.

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\* Of the references mentioned in the text the authors have given only six in the list.—EDITOR, I. M. G.

## A NOTE ON PARANITRANILINE POISONING

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PARANITRANILINE is frequently used in the preparation of red dyes. It is therefore fair to presume that a certain number of cases of poisoning from this chemical would occur, but the only references made to it are found in the reports of the chemical examiners of Calcutta and Bombay which rarely, if ever, are available to the medical profession in general.

Within the space of a few months, six or seven cases of paranitraniline poisoning were admitted into the various hospitals in Bombay.

**Chemistry.**—Paranitraniline ( $C_6H_4NO_2NH_2$ ) is a nitro- and amido-derivative of benzene. It is a yellow powder prepared from parachloronitrobenzene or acetanilide, and is used in the manufacture of the red dye paranitraniline red. It is a chemical generally imported by textile mills and other dyeing factories. It is easily soluble in alcohol, ether, and sparingly soluble in hot water. Beautiful long crystals are obtained if it is made to separate out from dilute alcohol. The melting point of the pure product is  $147^\circ C$ . On reduction with tin and strong hydrochloric acid, it yields paraphenylenediamine which can be readily identified by its melting point.

**Toxicology.**—Like all amido- and nitro-derivatives of benzene, e.g. dinitrobenzene and aniline, this dye is poisonous; and of the nitro-compounds of aniline ( $C_6H_5NH_2$ ), paranitraniline is the most poisonous. It is very interesting to note that the symptoms and effects produced by both the nitro- and amido-compounds are allied to one another.

Poisoning by paranitraniline through ingestion of the powder rarely takes place, as it is not easily absorbed by a full stomach. Inhaled as dust it sets up poisonous symptoms, but the chief manner in which it is commonly absorbed is through the skin. It has been found that most of the cases of poisoning occurred during the hotter part of the day or during the summer months. This is because the sweat helps to dissolve the dust on the skin, and dilatation of the surface vessels aids in the absorption of the dye. Moreover, paranitraniline being a powder adheres to the wet body. In industry the process of packing, loading, and unloading supplies the greatest number of casualties, as in such cases the powder is apt to settle over the whole surface of the body unless an efficient system of exhaust ventilation exists.

An empty stomach helps in the absorption of the dye, and indulgence in alcohol precipitates an attack just as in plumbism.

The elements most affected are the central nervous system and the blood. The hæmoglobin of the red blood cells is changed to methæmoglobin, the blood taking on a chocolate colour. This causes a state of internal asphyxia and

air-hunger. The central nervous system is paralysed. Death is usually due to cardiac paralysis.

Amido-compounds of benzene after excretion into the bladder have an irritating effect on this organ, producing not only cystitis, but even malignant growths.

Another closely related compound, metanitriline, which is used in the preparation of alizarine yellow and other dyes, is also poisonous, and the symptoms produced are akin to those caused by the para-compound.

**Symptoms.**—Before the onset of severe symptoms, which generally come on after cessation of work, there is a feeling of weakness and nausea, and sometimes giddiness. In one reported case, only cyanosis of the lips and ears was noticed which however disappeared by next morning. The man resumed work, though he looked pale and weak. Suddenly he collapsed and died from cardiac paralysis.

In the milder cases that occurred in Bombay, the men after working the whole day in packing the powder in boxes, felt weak and tottering in the evening. Soon after, they became unconscious, and were therefore removed to hospital. Some exhibited twitchings and clonic movements of the upper extremities.

In the more serious cases in which absorption was on a large scale, the patients vomited and soon became unconscious, cold and clammy; reflexes were lost, the pupil being dilated and fixed. There was marked cyanosis, lips, tongue, and nails all appearing dark blue or black. When the finger was punctured for obtaining a blood smear, it was noticed that the blood was chocolate-coloured, and that it clotted rather easily. The lack of oxygenated blood caused air-hunger, a rapid feeble pulse due to its action on the heart, and finally coma brought on by irritation of the medulla. The temperature usually rose to over  $100^\circ$ , even up to  $105^\circ$ .

The milder cases improved gradually the next day, but those patients who had absorbed a large amount of the poison died without regaining consciousness. The blood pressure was not affected in any of the patients. It is stated that in some fatal cases convulsions appear just before death.

Paranitraniline causes eczema, specially when, in the form of a solution, it is used during the process of imparting a red colour to fabrics. The solution comes in contact with the hands and chest of the dyers and this produces a serious form of chronic eczema known as 'purpurism'. It was found that the use of gloves or machinery eliminated this disease altogether.

Those exposed to paranitraniline over a long period are apt to suffer from vertigo, headaches, weakness of the limbs, inflammation of the liver and increased perspiration, as well as the bladder tumours referred to above.

**Diagnosis.**—The characteristic of these cases is marked cyanosis. The chocolate-coloured

blood should be examined spectroscopically for the bands of methæmoglobin. Very often a compound appears in the urine which reduces Fehling's solution. If the patient lingers for some time, hæmoglobin liberated through the destruction of red blood cells is excreted as hydrobilirubin and hæmatoporphyrin, and the latter may therefore be looked for in the urine.

An oxidation product, para-amino-phenol, which is excreted in the urine, can be extracted by means of ether after rendering the urine neutral. The residue after removal of ether may be tested for the above compound by the following reactions :—

(1) Boiling with Millon's reagent produces a violet colour which quickly fades to brown.

(2) A violet coloration is also obtained with ferric chloride solution.

(3) Bromine water produces a violet colour which disappears with excess of reagent.

In some cases paranitraniline itself can be demonstrated in the urine.

**Prevention.**—As the skin is the chief portal of entry, scrupulous cleanliness is the main precaution for preventing cases of this form of poisoning. As far as possible, work should be suspended during the hotter months of the year. If this is not possible for any reason, work should only be permitted in the early hours of the morning before the heat begins. Exhaust ventilation to prevent the dissemination of dust is a necessary adjunct. Facilities for bathing with hot water as well as for frequent washing of hands and face during work should be provided. In well-equipped plants, tub baths are erected and some solvent is added to aid the removal of the poison from off the body. As women and children under eighteen are more prone to poisoning, they ought to be excluded from such work. Needless to say, strict medical supervision is absolutely necessary. Any workman who complains of ill-health should be immediately directed to take a full bath and change all clothing including underwear. He must then be thoroughly examined by the factory physician.

Lastly, strict factory laws must be enacted so that every single case of poisoning is immediately reported, compensation paid, and precautions taken against recurrence.

**Treatment.**—As soon as symptoms are noticed, the patient is taken out into the fresh air and if necessary treated by artificial respiration. Paranitraniline being easily soluble in alcohol, it is advisable to wash the body with this solvent. Removal of blood and its immediate replacement by blood transfusion may prove a very useful measure. Continuous administration of oxygen is resorted to. As the dye paralyses various brain centres, stimulants such as strychnine, adrenalin, cardiazol or lobeline should be administered. The cyanosis present in this form of poisoning is due to the presence of methamoglobin as in the case of sulphanilamide

intoxication. Therefore administration of methylene blue orally or by injection is indicated.

**Post-mortem appearances.**—The general picture that presents itself at the *post mortem* is one of congestion. The lungs, liver, spleen, and kidneys all appear enlarged and dark or blue. The stomach and intestines are inflamed, and one of the cases showed submucous hæmorrhages. The bladder contained yellow-coloured urine.

Sections of the liver and kidneys were made, but they failed to demonstrate any lesion.

**Chemical analysis.**—The viscera of two fatal cases were extracted with alcohol which resulted in a yellow fluorescent solution. The residue from this gave tests for paranitraniline. The yellow powder handled by the patients was also sent for test and this on analysis was confirmed as the dye in question.

**Case I.**—On 15th December, 1941, five workers in a dyeing factory, four men and one woman, were packing paranitraniline powder. In the evening they felt giddy and later on three of them became unconscious and were therefore removed to the J. J. Hospital. The other two became unconscious gradually the next day, and were admitted into the K. E. M. Hospital.

(a) R. A., female, *æt.* 25, widow, admitted unconscious on 15th December, 1941. Restless, pupils dilated and fixed. All muscles were flaccid and reflexes could not be elicited. Urine—nothing abnormal. Red cells 3 million, leucocytes 4,000, polymorphonuclears 78 per cent, lymphocytes 15 per cent, monocytes 5 per cent, eosinophils 2 per cent. Pulse 90, respiration 38, temperature 96.5. Blood pressure 100/80.

16th December. Patient improving, temperature 101.5.

17th December. Patient conscious and normal. Left 18th December.

Treatment. Cardiamid and glucose.

(b) R. R., male, *æt.* 30, admitted on 15th December, 1941, unconscious and sweating. Limbs spastic, pupils dilated and fixed. Reflexes all brisk. Blood—polymorphonuclears 67 per cent, lymphocytes 30 per cent, monocytes 2 per cent, eosinophils 1 per cent. Blood pressure 120/70. Temperature normal.

16th December. Temperature 99.5, patient conscious and normal.

Discharged on 18th December.

(c) N. R., male, *æt.* 25, admitted at 10-10 p.m. on 15th December, 1941. Patient unconscious, lies quietly in bed but exhibits occasional twitchings of muscles of the shoulder girdle. Pupils normal. Tongue blue, respiration 30, pulse 116, temperature 98. Urine—nothing abnormal. Blood—chocolate coloured and clots easily.

16th December. Patient conscious and normal. Temperature 99.

Discharged on 18th December.

**Case II.**—Two coolies were employed in loading packets of paranitraniline on to a lorry at 9 a.m. on 17th April, 1942. One of the packets was damaged and the powder leaked out. It is stated 'the coolies threw handfuls of the powder at each other and also at the driver of the lorry, and rubbed some of it on their bodies'. They took meals at noon and resumed work of loading another lorry with bags of white clay. At 1-30 p.m. both the coolies vomited, felt faint and became unconscious. They had twitchings of their limbs. They were admitted into G. T. Hospital.

(a) D. B., male, *æt.* 32, admitted into hospital on 17th April, 1942, unconscious, intensely cyanosed, cold and perspiring profusely. Pupils dilated and fixed. Reflexes absent. Pulse 120, feeble but regular. Respiration gasping. Temperature at noon 97, rose to 103 in the evening. Patient died at 1-45 a.m. next day (18th April).

(Concluded on opposite page)

## THE CONTROL OF ANOPHELES MINIMUS BY 'SHADE' AND RELATED METHODS

By R. C. MUIRHEAD THOMSON, D.Sc.

Research Worker supported by the Royal Society and the London School of Hygiene and Tropical Medicine

DURING the last ten or fifteen years there have been rapid advances in the control of *A. minimus* in Assam and North Bengal, and one of the most interesting features of this campaign has been the widespread and increasing use of 'shade' as a control measure in the tea districts (Ramsay, 1930; Ramsay and Macdonald, 1936). Although the efficiency of this simple method was well established, there was some doubt as to the exact way in which it worked, and accordingly an investigation was started in 1938 the main object of which was to find out the principles underlying control by 'shade', and if possible to put this and related methods of control on a firmer scientific basis. In order to tackle this

(Continued from previous page)

(b) G. D., male, *æ*t. 35, admitted into hospital at 2-40 p.m. on 17th April, 1942, unconscious, cyanosed, cold and clammy. Pupils dilated and fixed. Jerks sluggish. Pulse 85, feeble, and regular. Respiration gasping. Temperature rose to 103. Urine examined on 18th April—albumin traces, sugar 0.5 per cent, bile present, casts granular, a few.

18th April. Patient's condition same, intensely cyanosed and frothing at the mouth. Temperature came down to 100. Pulse—volume good and regular. Patient catheterized, 28 oz. urine of deep yellow colour resulting.

20th April. Condition same. Temperature rose to 105 in the evening and patient died at 8-30 p.m.

(c) The lorry driver against whom the powder was thrown suffered from giddiness and twitching of the limbs in the evening. He was treated in a private hospital and discharged.

**Conclusion.**—The incidence of industrial poisoning though not high is increasing in India. It is likely that in the near future, when industrialization is speeded up, industrial diseases will occur much more frequently than heretofore.

Though such diseases are usually dealt with in the larger textbooks used by medical students, very little attention is paid to them in our colleges. Hence no importance is attached to industrial toxicology, a highly interesting branch of medicine.

The first five cases of paranitraniline poisoning occurred in December 1941. Three months later, three more workers were poisoned by the same dye, two of whom died of the effects of the poison. The latter accident would certainly have been avoided if warning had been given and precautions taken in time.

### Acknowledgments

I am very grateful to the superintendents of the Jamsetji Jijibhoy Group of Hospitals and of the Goculdas Tejpal Hospital for allowing me to make use of their hospital records and also to the Chemical Analyst to the Government of Bombay, for permitting me to publish in the medical press the results of toxicological analyses.

problem it was necessary to study the reactions of *A. minimus* and its larvæ to different components of the environment in turn, such as light and shade, water movement, temperature, organic pollution, etc., and the reports on these separate aspects of the work have been published from time to time in the *Journal of the Malaria Institute of India* (Thomson, 1940, 1941). As these published results contain full details of all laboratory and field experiments on which the following conclusions are based, the reader might encounter difficulty in selecting from all that material those findings which lend themselves to direct practical application in control work. When the investigation came to an end in 1941 it was therefore felt that the time had come to review the work of the previous 3½ years and to discuss its practical possibilities. As the question of 'shade' is the one that claims first attention, it seems advisable to publish a preliminary communication to clear up some points which might previously have lent themselves to misinterpretation. One of the first points is that in the following account the system of control known as 'shade' will be printed in inverted commas in order to avoid confusion with shade as distinct from light, and it will soon become evident why this distinction is necessary.

If we select a grassy edged garden drain where *A. minimus* is breeding, and shade a section with bamboo matting or thatch, *A. minimus* continues to breed in the dense shade as long as the grassy edge remains. Dense shade by itself will not kill the larvæ, nor prevent the female mosquito from laying its eggs. When the grassy edge under the bamboo matting dies after a few weeks, in the same way as it does under 'shade' hedges of lantana, eupatorium, titapat, etc., *A. minimus* disappears.

Now if we clean weed a stretch of the same garden drain, to produce bare earth edges exposed to light, *A. minimus* is again eliminated. It appears therefore that the breeding place becomes unsuitable for *A. minimus* under 'shade' not because of low illumination but because of the ultimate disappearance of the grassy edge.

Our experiments also showed that the female *A. minimus* lays its eggs in the still water among the grass at the edge of the stream. When the grassy edge is clean weeded or removed by the action of 'shade', the increased water movement makes it unattractive to the female. Similarly, the larvæ of this mosquito are really very susceptible to water movement. Normally they are well protected by the still water among the grass at the very edge of the stream. When the grassy edge is removed, the increased flow makes it difficult for existing larvæ to maintain their position, and they are very liable to be washed away.

It appears therefore that the absence of *A. minimus* from streams under 'shade', and also its absence from streams whose edges have been clean weeded and exposed to light, is really due

to the same cause, namely, the removal of the grassy edge and the resulting increased water movement.\*

We have noted above that the shade or low illumination itself is not repellent to *A. minimus*. In fact when the female mosquito is looking for a place to lay its eggs, it is attracted by a certain amount of shade, such as exists in among a thick grassy edge, or a shaded pool or pocket of water at the edge of the stream. In some parts of Assam *A. minimus* is found breeding in little dark pits or 'crab-holes' in the bank of the stream, and it is obvious that the low illumination itself has no harmful or deterrent effect. In streams, the attraction of *A. minimus* to a shaded spot is overruled by the repellent effect of moving water at the edges, but in the still water of *katcha* wells, where *A. minimus* also breeds, the reactions of the female to shade have a direct bearing on control. If we remove the vegetation from the well there is no increase in water movement such as occurs when the grassy edge of a stream is destroyed by 'shade' or by clean weeding. In the deeper wells, where the edges are shaded by the vertical or overhanging earth walls, breeding of *A. minimus* will still continue. But if the clean-weeded edges are fully exposed to light by converting vertical walls into smooth sloping ones, *A. minimus* is no longer attracted, and effective control is brought about.

If these fundamental facts about the influence of light, shade, and water movement are borne in

mind, it will be seen that there is nothing incongruous about the fact that streams can be controlled equally well by 'shade' and by clean weeding, and that the two methods of control are really due to the same causes. Clean weeding is merely a subsidiary method which has been evolved during the course of experiments directed towards an explanation of control by 'shade'. The removal of the grassy edges of a stream and exposure of the bare edges to light is a sound and simple control measure, recommended as a temporary method to be applied in places where 'shade' does not exist or where it would be impracticable to plant it. It should be a particularly useful control measure at the edges of broad streams and perennial rivers, and in rural areas where it is difficult to establish and maintain good 'shade'.

The studies on the behaviour of the mosquito have shown that there is nothing antagonistic about what appear to be two very different methods of control, 'shade' and clean weeding. In fact, we may regard 'shade' as a more permanent form of clean weeding, and both measures could be considered as forms of flushing, since the increase in flow or movement of water at the edges is the main factor which renders the breeding place unsuitable in all these cases.

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\*This is only a partial explanation of control by the shade plant, tarapat.

## A Mirror of Hospital Practice

### A FEW UNUSUAL CASES OF POISONING

By M. M. SYDDIQ HUSSAIN, M.B., B.S. (Punjab),  
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 D.T.M. & H. (Lond.), D.O.M.S. (Lond.)

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 Hyderabad (Deccan)

**Case 1.**—A Hindu female from district Warangal, Hyderabad (July 1940), killed her husband by giving him a drink containing ground *Bhilawan* (marking nut) and snake poison. No snake poison was detected but *Bhilawan* was detected on a stone on which it was ground and in the remnant of the prepared poison which she said she gave to her husband. It could not be detected in earth soiled with vomited matter nor on a *dhoti* soiled with stools.

The man presented symptoms of severe gastro-intestinal irritation. He died within twelve hours. Quantity administered was not known.

**Case 2.**—A Hindu female from district Raichur (February 1942) administered with her finger 'something' to a child seven months old. The child started vomiting and diarrhoea soon after. There were blisters on his tongue. A blister also appeared on the part of the chest that was touched by the soiled finger. The child died within twenty-four hours. On the piece of stomach sent to me, there were several blisters

on the mucous membrane and small black particles were sticking to the mucous membrane all over. The particles proved to be *Bhilawan*. Later, the woman confessed to have given *Bhilawan* to the child and a box (tin) containing ground *Bhilawan* was found on her. Some unknown alkaloid was also detected in the *post-mortem* organs which failed to kill a frog even in large doses. No alkaloid was present in the acid extract.

**Case 3.**—A Hindu male, aged 22 years, from district Nalgonda (June 1940) committed suicide by taking a whitish salt at 12 noon. One hour later he was trembling all over, with fists clenched and shouting incoherently, partly unconscious. Vomited once and passed two liquid stools. Died at 6 p.m. Sodium nitrite (not nitrate) was found in the *post-mortem* organ and on a soiled *dhoti*, etc. A tin containing a salt was also recovered by the police. This salt was also sodium nitrite.

**Case 4.**—A woman from Nalgonda (September 1940), it was alleged, was bitten by a snake in the morning and died after two hours, but no sign of snake bite was found on the body. *Post mortem* the organs contained sodium nitrite. Later it was discovered that a man had two wives, the senior wife (deceased) complained of backache, so the junior wife said that she would give her some decoction of anisi seeds. With the decoction she mixed a 'salt' and gave it to the deceased. Soon after the victim began to feel

uncertain about herself, and became unconscious. Vomited once and passed one liquid stool. She died within three hours. The amount administered was about half an ounce in this case. Some more salt was found on her hidden in a box. It was also sodium nitrite. No cases of sodium nitrite poisoning are recorded, so far as I know.

*Case 5.*—A Mohammedan male, aged 25 years, from Hyderabad (January 1940) thought there was some water in a cup and drank it. Soon after he felt a burning sensation in the stomach. He vomited several times and had a good many watery stools. He walked to the hospital and was quite sensible. The stomach washings contained sodium thiosulphate. The salt was kept in the house for photographic purposes, as stated by the patient.

*Case 6.*—A Mohammedan female, aged 20 years, from Osmanabad district (October 1941) was suffering from venereal disease. Her husband asked a local amateur physician to treat her. They took her to the fields where some medicine was administered to her. Soon after she had diarrhoea and vomiting; towards the evening she passed away. The physician said he had administered to her two crushed insects without the wings. Two such insects were also sent to me. The wings had black and yellow stripes, and there were similar stripes on the thorax and abdomen of the insects. From the *post-mortem* organ and the insects an alkaloid was obtained. When this was injected into the frog, the latter became very sluggish but did not die. No cantharidin was obtained.

In another case, one of suspected alcohol poisoning, *post-mortem* organs were sent to me in concentrated salt solution. After distillation and extraction, the residual watery solution instantaneously killed the frog. Chemically however no poison could be detected. Later a control sample of concentrated salt solution was injected into the frog, repeatedly with similar results. Therefore simple concentrated sodium chloride solution is very fatal to frogs.

*Note.*—These reports of a chemical examiner are of more interest from an administrative and legal point of view than from a medical.—Editor, I. M. G.

## A CASE OF TETANUS SIMULATING ACUTE ABDOMEN

By N. LAHA, L.M.P.

*Medical Officer, Jashpur State, Eastern States Agency*

An adult male, aged 22 years, was admitted on 4th January, 1942, at 10 a.m., into the Deosaran Hospital for the following complaints :—

- (1) Pain in the whole of the abdomen—duration 10 hours.
- (2) Faecal stasis—duration two days.
- (3) Absence of micturition—duration 10 hours.
- (4) Vomiting once the night before admission.

*Present illness.*—Two days back the patient attended the dispensary for some pain in the neck and was treated with sodium salicylate mixture, local anodyne and a purgative. About 10 hours back, after his supper he vomited once and felt intense pain round the umbilicus which was of colicky nature and referred to the whole of the abdomen. He did not pass any urine since then and had no motion for the last two days.

*On examination.*—Pulse—120 per minute. Temperature—normal. Patient restless and much distressed. The whole of the abdomen was rigid and tender, and on percussion it was tympanitic. No area of maximum tenderness elicited. He was given the following treatment :—

- (i) atropine sulphate gr. 1/100 intramuscularly,
- (ii) soap-water enema,
- (iii) catheterization,
- (iv) glucose water in sips by mouth.

About 2 ounces of urine was evacuated but no faecal matter came out with enema. Pain was not relieved,

but came on intermittently when the abdomen became rigid. In between the pains, the abdomen was relaxed. Any attempt at palpation was followed by spasmodic contraction of the abdominal muscles.

The case was diagnosed as one of acute obstruction, and it was decided to open the abdomen, but the patient's relatives were against any operation.

As the colicky pains were devitalizing the patient's general condition, morphia gr.  $\frac{1}{4}$  was given intramuscularly, and glucose saline administered per rectum. In the afternoon the pulse was 100 per minute, temperature normal, and pain in the abdomen same. Hot water bags were applied.

*5th January.*—Pulse 100 per minute. No rise of temperature. Bowels not moved and no urine voided. The patient got the same sort of intermittent colicky pains with tender and rigid abdomen. He now complained of maximum tenderness at McBurney's point, where no rigidity was found in the intervals.

No permission was obtained for operation and so the following treatment was again given :—

- (i) soap-water enema and flatus tube per rectum,
- (ii) catheterization twice a day,
- (iii) patient was put in Fowler's position, and anti-phlogistine was applied on the right iliac region,
- (iv) morphia  $\frac{1}{4}$  gr. intramuscularly,
- (v) glucose water by mouth in sips,
- (vi) paraldehyde 2 drachms in normal saline was given per rectum at night.

Bowels were not moved. Pain in the abdomen was same.

*6th January.*—Pulse 90 per minute. Temperature normal. The spasms of pain and contraction of the abdomen came on more frequently. Abdomen was distended, and rigid and tender during the pains. Maximum tenderness at McBurney's point. Patient passed urine twice at night by himself.

The same treatment was repeated with the omission of enema and morphia.

*7th January.*—Pulse 84 per minute. Temperature normal. Bowels not moved. Urine passed once in the morning.

Patient now complained of pain and rigidity of the neck and inability of opening the mouth properly. With each spasm of contraction the mouth was closed, the facial muscles contracted, the abdomen became rigid and distended, the whole spine was stretched and the patient rested on his heels and occiput. Previous to this he never complained of any lock-jaw.

History revealed some injury by fall from a bicycle, and on examination a healed scratch was found on the right hand.

A diagnosis of tetanus was made. The wound in the hand was cauterized with carbolic acid after an incision, and the following treatment given :—

- (i) anti-tetanic serum 6,000 units intramuscularly,
- (ii) morphine gr.  $\frac{1}{4}$  and atropine sulphate gr. 1/100 intramuscularly.

Towards the evening the spasms were more prolonged. Another injection of serum 10,500 units was given intramuscularly.

*8th January.*—Pulse 90 per minute. No rise of temperature. The spasms continued with contraction of the spine, and lock-jaw, but more prolonged. Bowels not yet moved and the abdomen was rigid and tender during contraction. He was given :—

- (i) soap-water enema,
- (ii) anti-tetanic serum 9,000 units intramuscularly,
- (iii) 25 per cent solution of magnesium sulphate 10 c.cm. intravenously, and
- (iv) a chloral and bromide mixture thrice daily.

In the evening he had another injection of the 25 per cent magnesium sulphate solution, 8 c.cm. intravenously and serum 10,500 units intramuscularly.

*9th January.*—Bowels moved once at night. Pulse 92 per minute. Temperature normal. Spasms prolonged. He was given :—

- (i) 50 per cent magnesium sulphate solution 6 ounces per rectum,
- (ii) anti-tetanic serum 6,000 units intramuscularly,



(iii) 25 per cent magnesium sulphate solution 10 c.cm. intravenously, and  
 (iv) chloral and bromide mixture thrice daily.  
 In the evening bowels moved twice, urine passed twice. Pulse 86 per minute. Abdomen relaxed and spasm less.

He was given—

- (i) anti-tetanic serum 10,000 units intramuscularly,
- (ii) 25 per cent magnesium sulphate solution 10 c.cm. intravenously.

10th January.—He was more quiet. Pulse 80 per minute. No rise of temperature. Spasms sluggish. Bowels moved once at night. Urine passed at night and in the morning. He was given:—

- (i) anti-tetanic serum 20,000 units intramuscularly,
- (ii) 25 per cent solution of magnesium sulphate 8 c.cm. intravenously, and
- (iii) chloral and bromide mixture thrice daily.

Another dose of 10,000 units serum was given in the evening.

After this 40,000 units of serum intramuscularly and 25 per cent solution of magnesium sulphate 10 c.cm. intravenously were continued twice daily for two days more. Thereafter the former was reduced to half the dose and continued for five days more and then stopped. The patient then made an uneventful recovery and was discharged cured on 20th February. He is now leading a healthy normal life.

*Summary of the case.*—The patient, an adult male, attended the out-door for some pain in the neck which was thought to be rheumatic and was treated accordingly. He was then admitted after two days into the hospital ward for acute abdominal obstruction for which an operation was decided upon. But as no permission was obtained for operation the surgical intervention was deferred. Three days after, he showed signs of tetanus. He was initially given low doses of anti-tetanic serum combined with 25 per cent magnesium sulphate solution intravenously, a devise which was made as our stock of the serum was limited. Then higher doses of serum were given, and the patient made an uneventful recovery.

#### *Points of interest*

(i) Tetanus resembling acute abdominal obstruction.

(ii) Even low doses of anti-tetanic serum combined with 25 per cent solution of magnesium sulphate can be given with confidence, proving\* the efficacy of the latter in the disease.

My thanks are due to my chief Dr. P. K. Roy, M.B., for kindly going through this paper and permitting me to submit it for publication.

### A CASE OF GAS GANGRENE

By N. R. KONAR, M.B.  
 Civil Medical Officer, Kurseong

S. B. C., male, aged 14 years, was admitted into the hospital on the 19th May, 1942, at about 2 p.m., for the treatment of a lacerated wound on the back of his right leg, caused by an accidental fall from a tree at about 9 a.m. The wound involved almost the whole of the back of the right leg. The calf muscles were badly lacerated and the wound was full of dirt. The temperature on admission was 99.8°F., pulse 118 and respiration 28 per minute. His general condition was good. The wound was cleaned with antiseptic lotions and ether, and the edges which were widely

apart were stitched together. Anti-tetanic serum, 1,500 international units, was injected. He was put on an alkaline mixture and sulphonamide tablets (septanilam 0.5 gramme) 6 a day divided in 3 doses. An injection of morphia grain 1/6 with atropine grain 1/200 was also given to relieve the pain. On the next morning the temperature was 103°F. Pulse rate was 130 and respiration 30 per minute. The patient was toxic and his tongue was dry and coated. It was noticed that gas gangrene had started over the injured part. The wound was blackish in colour and crepitus was elicited over an area which extended above the knee and below the heel. Considering the toxic condition of the patient it was seriously considered whether the leg should be sacrificed to save his life. Before deciding finally to operate on him, the following line of treatment was adopted: The stitches were removed, the wound was widely opened up, the dead tissues were snipped off, the part was thoroughly washed with hydrogen peroxide solution and sulphonamide powder prepared by crushing septanilam tablets was applied liberally over the wound. The sulphonamide dressing was changed twice a day. On the same day he had an injection of anti-gas-gangrene serum of 8,000 units intramuscularly. Along with the local application of the powder, 6 tablets of septanilam 0.5 gramme each were given daily by mouth. The temperature was less on the next day and by 48 hours of the beginning of the treatment it came down to normal. Along with it the condition of the patient and the wound improved remarkably. The toxæmia was much less, the tongue was moist though still coated, the spread of the gangrene had stopped and the wound looked healthy. The sulphonamide dressing and oral administration of the tablets were continued till the 25th May. The patient still had slight rise of temperature which however settled by the 1st June. As no more anti-gas-gangrene serum was available locally and the condition of the patient improved, the injections of the serum were not continued. He stayed in the hospital till the 23rd August, as the large raw area on the back of his leg took a long time to heal. A good amount of scar tissue was formed as he refused to undergo the operation for skin grafting.

The present position of the topical application of sulphonamides has been reviewed by Hamburger (1942). Hawking (1941) carried out experiments in determining the efficacy of local application in preventing gas gangrene. He however advocated simultaneous use of anti-gas-gangrene serum with the topical application of sulphonamides. Opinion is still divided as to the efficacy of anti-gas-gangrene serum once gangrene has definitely started. Though in the present case sulphonamide was given from the beginning it could not prevent gas gangrene as the drug was probably not present in sufficient concentration in the blood before the onset of the disease. It is difficult to assess the value of the small amount of the serum used in this case. However to tackle such a grave infection it may be a good plan to attack the disease in all possible ways, e.g. oral and topical use of sulphonamides and the administration of serum.

My thanks are due to Lieut.-Colonel G. H. Mahony, I.M.S., civil surgeon, Darjeeling, for kindly allowing me to publish the report of the case. I have also to thank Dr. K. L. Bose, medical officer, Kurseong, for recording the data of the case.

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[\*The recovery of one such treated case proves nothing. Such cases may recover without treatment.—Eppron, I. M. G.]

# Indian Medical Gazette

NOVEMBER

## THE 'AUSTERITY' COURSE OF QUININE AND THE PRESENT SHORTAGE OF ANTIMALARIAL DRUGS

THE present position in which India is placed regarding quinine is a tragedy, a tragedy that could so easily have been obviated. It is unnecessary to recount in detail the history of cinchona cultivation in India, as the subject has been discussed editorially in this journal on several occasions during the last ten years or so.

The story, told in a few words, is that in the middle of the last century India and Ceylon were far ahead of Java in cinchona cultivation. So much cinchona was grown that there was a slump. The price of quinine fell so low that the cultivation ceased to be a paying proposition, with the result that practically all the commercial concerns engaged in growing cinchona went into liquidation, and private cultivation of cinchona practically ceased. The Government of India at that time might very well have shown more foresight and fostered the cinchona industry in the way the Dutch Government did for their industry in Java. They did however see the wisdom of growing cinchona for their own requirements, and plantations were started, or maintained, in several parts of the country. For many years in this journal we have advocated the adoption of some forward cinchona policy in this country, but nothing has been done in the matter and now we are faced with this very difficult position.

For a number of years the average consumption of quinine in India has been about 200,000 pounds annually; this is of course far below her real requirements which can be placed, on a conservative estimate, at a million pounds. The amount of quinine and other cinchona alkaloids obtainable from the cinchona grown in India is about 70,000 pounds. There is thus a deficit of 130,000 pounds, which has had to be imported annually to meet our normal requirements.

It is of course too late to consider the question of meeting the present emergency by extending cinchona plantation, since it takes eight years at least for the plant to reach maturity; consequently the strictest economy in quinine consumption will have to be practised in India.

The teaching regarding the treatment of malaria has undergone a very striking change during the last twenty years. Quinine is a specific for malaria; it can be taken in relatively large doses over a long period without doing the patient any harm; it was therefore argued that

the longer the course of treatment, the better are the chances of complete cure. The treatment course prescribed covered a period of two months, and the amount of drug consumed ran to several ounces. There has however been a new principle creeping into the practice of malaria therapy. It is realized that it is not the drug but the patient's resistance that knocks out the malaria parasite, and that the drug only helps the human organism in its fight against the parasite. It is believed, on very sound grounds, that the patient's resistance, or immunity, will be greatest if it is allowed to develop naturally and the quinine is kept as a reserve that is thrown in at a critical moment in the struggle between man's resistance and the parasitic infection. Quinine given over long periods is thought to depress rather than increase immunity. Therefore the tendency for some years has been to give shorter and shorter courses of quinine treatment and to allow the patient's immunity full play.

This is not by any means based on purely theoretical grounds, for it has been shown that, in benign tertian infections, the percentage relapse rate is barely influenced by the amount of quinine given provided the dose is not allowed to fall below a certain minimum. It is mainly on what this amount should be that experts disagree. Such disagreement is very natural, in view of the fact that malaria strains differ so much in their response to treatment, some requiring many times as much drug to knock them out as do others. A compromise has been arrived at by the League of Nations Health Organization Malaria Committee who in its Fourth Report place it at a maximum of 7 days' treatment of 30 grains a day, or a total of 210 grains.

The new situation that has now arisen naturally makes it necessary for all of us to revise our opinions and even those who favoured a much larger dosage of quinine are now prepared at least to give a trial to the shorter course, advocated, not as a measure of economy but as the best course of treatment, by some of their colleagues. We shall await the results with great interest; it is an ill wind—and it is quite conceivable that when once again more quinine begins to flow to, or better still grow in, India, there will be many converts to the shorter course of quinine; on the other hand, it is possible that many doubters will have been convinced of its inadequacy by personal trial.

There have been during the last few months a number of letters and articles by medical men in the public press in India, on the subject of quinine treatment of malaria. Contrary opinions have been expressed, to the confusion of the lay reader and the embarrassment of the medical profession. We are in entire agreement with our correspondent (see p. 701) that the public press is not the place for medical men to air personal points of view, though informative articles on medical subjects may in some circumstances be

seemly and useful. We therefore welcome the authoritative paper which Colonel Covell, the director of the Malaria Institute of India, has contributed to our present number. Most of the points that we have touched on and others are dealt with in his paper.

There is another aspect of this subject. The cinchona alkaloids are not the only drugs that cure malaria. There are some very potent synthetic compounds that do this also. Why cannot these be used? They can be and are being used, but before the war these drugs were made mainly in Germany. They are relatively easy to synthesize on a small scale, but their wholesale production is a much more difficult matter.

Atebrin or, to use the *British Pharmacopœia* word, mepacrine was synthesized in India even before the war, and it can be and is being prepared on a small scale in India to-day. But its preparation needs a number of chemical substances that are not available in India. Even if Britain and America were prepared to export these basic chemical substances, something like 16 tons are required to prepare one ton of mepacrine (we must think in tons and not pounds), and, in addition to this, much machinery would have to be imported. Therefore, to meet our immediate requirements, it would not be sound policy to do this, and it would be far better to import the finished article. Before the war, or even before the loss of Java, neither Great Britain nor America was manufacturing mepacrine on a large scale. For larger scale production, time is required and though much headway has already been made and this drug is beginning to arrive in this country in increasing quantities, it will probably be at least another year before we have sufficient for all our requirements.

Is there any other source of antimalarial remedies? The Indian indigenous system contains a very large number of drugs that are reputed to be either febrifuges or actually specifics against malaria. This source should certainly be investigated. Many of these drugs have already been tested and shown to be of little or no value in the treatment of malaria, but there are certainly others that should be similarly investigated.

Advantage has been taken of the present situation both by genuine enthusiasts for some indigenous drug, and by the opportunist exploiters who hope to make money out of some secret remedy. The latter in particular are not hesitating to make political capital out of the inevitable refusal of co-operation that they receive from scientists and particularly from those working in government institutions, and non-medical administrators are very liable to be misled by the plausible stories that these enthusiasts or that charlatans tell. This is no time for academic or purely scientific investigation; any work undertaken should have a direct immediate application to the present situation.

Before a government officer or institution undertakes to investigate a drug, certain facts should be ascertained:—

The exact composition of the drug, in order that it can be made again in exactly the same form.

Whether the different ingredients are available in sufficient quantities for the drug to be made on a large scale, or, if it is made from an indigenous plant, whether this plant is available, or can be cultivated at short notice, in sufficiently large quantities.

Whether it will be possible to organize the manufacture or preparation of the drug on a sufficiently large scale, so that it will be available for the general population within a reasonably short time.

Finally, whether the cost will be sufficiently low for its general adoption by the poorer members of the community.

Further, a sufficient amount must be provided for a proper clinical trial. It is useless for the discoverer, or rediscoverer, of some new, or old, specific to produce enough of the drug to treat a couple of cases only, as spontaneous remission is the rule in malaria, and at least twenty cases should be treated before any opinion can be given regarding the clinical efficacy of such a drug.

Every reasonable effort should be made to supplement the available antimalarial drugs, and if any indigenous drug, that is available in large quantities, is shown to be efficacious, full use should be made of it, but it will not serve the nation's interest to demonstrate that Dr. X's specific for malaria is in fact efficacious in this disease, if only Dr. X knows the formula and he can only produce the drug on a very limited scale, though it may fill Dr. X's pockets for him.

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## Special Article

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### COMMENTS ON THE HISTORY OF LEPROSY

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For a number of years the writer has been collecting material on the history of leprosy. No comprehensive account of this subject has been traced, although there are numerous excellent papers on individual countries and periods. The writer has, however, been struck by the lack of sound evidence to support statements sometimes made on this subject even by well-known writers. These statements are apparently copied without verification from earlier to later editions and from older to newer books.

It was in the late eighteenth century and in the nineteenth century that the history of leprosy aroused considerable interest, and several publications on the subject appeared. The first history, and in many ways the best, appears to have been that of Hensler (1790), and later historians included Shapter, Simpson, Virchow, Kaposi, Munro, Creighton, Newman, and others. Some statements made in the earlier books have since been shown to be untrue, but they are still quoted from time to time.

Most writers have expressed the view that in some countries in ancient times and in medieval Europe, leprosy was common, but early in the nineteenth century Shapter, and late in the nineteenth century Creighton and to some extent, Newman, expressed the view that the prevalence of leprosy in Europe in the Middle Ages might have been greatly exaggerated. A more recent writer in the same vein has been McArthur (1925; 1926), who used the following words regarding the published statements regarding the history of leprosy; 'Oh, history, what crimes have been committed in thy name'.

Actually the present writer thinks that this critical attitude is sometimes carried too far, and that the evidence indicates that leprosy in the past was both common and severe in Europe as well as Asia, but there is no doubt that there has been written much bad history of leprosy. In a new (1942) edition of a standard American book on tropical medicine, the chapter on leprosy includes an historical section in which some of the old mistakes have been repeated.

In the present article no attempt is made to discuss fully the history of leprosy, for it is a vast subject. It is proposed here to discuss a few of the commonest misconceptions about the ancient history of leprosy in the world as a whole, to make some general comments on the subject, and to adopt the principle that the use in ancient literature of a word which might have been used at that time for leprosy is of no value as evidence unless supported by clinical details definitely suggesting if not clearly indicating leprosy.

#### *Leprosy in ancient India*

It has been stated by many writers that leprosy is mentioned in the Vedic writings of India. The Rig Veda and the Atharva Veda have been cited. Rogers and Muir state that leprosy is mentioned as *kushta* in the Vedas of about 1400 B.C. although in the recent edition they say that it is not sure that *kushta* meant leprosy. *Kushta* (or more correctly *kushtha*) is now usually used specifically for leprosy but in ancient Hindu medicine it meant skin diseases in general, one of which was leprosy. In the Vedic writings the word *kushtha* appears in a very few places, and it is not certain that leprosy is meant. There is, however, no doubt that leprosy was well known and described in ancient India. Many writers have cited the *Susruth Samhita* as mentioning leprosy, and Dharmendra (1940) has recently quoted and translated those passages from the *Susruth Samhita* which have a bearing on this subject. The present recension of the *Susruth Samhita* was probably written about 600 B.C. but it embodies traditional knowledge from still more ancient times. The *Susruth Samhita* describes treatment of leprosy with chaulmoogra oil.

This is actually the most reliable ancient reference which I have been able to trace, and

it is also in many ways the most accurate and complete of the old descriptions. Under different heads it describes most of the signs and symptoms of leprosy, even in its milder forms with which we are familiar to-day. This fact suggests the possibility that in ancient times, as in the present times, leprosy in its milder forms may have been more common in India than in some other countries.

It has sometimes been stated by writers in India that the Laws of Manu contain definite instructions about the prophylaxis of leprosy. The Laws of Manu (the *Manava Dharma Sastra*) have been attributed by various European scholars to various periods between 500 and 1300 B.C. Sir William Jones placed the writing between 1200 and 500 B.C. Max Muller was of the opinion that in its present form it is of relatively recent date, but that its origin is much more ancient. In India it is popularly regarded as being of extreme antiquity.

Possible references to leprosy are made in four places. The Sanskrit word *shitri* almost certainly meant leucoderma, and *kushtha* meant skin diseases in general, prominent among which was possibly or probably leprosy. In Book III, sloka 161, a man suffering from *shitri* is included among the list of those who should not be present at religious ceremonies. In the same book, sloka 177, it is stated that the presence of a man who suffers from *shitri* causes the giver of the feast to lose the 'merit' acquired by entertaining one hundred suitable persons (Brahmins, etc.). In Book VIII, sloka 205, it is stated that if a man giving a girl in marriage has openly declared her blemishes, that she is insane, afflicted with *kushtha* or not a virgin, that man is not liable to punishment. In Book III, sloka 7 states that a 'twice-born' in choosing a wife should carefully avoid families whose members are subject, among other things, to *shitri* or *kushtha*. These are the possible references to leprosy detected in the translation of G. Buhler. A Sanskrit scholar has verified for me the accuracy of the above statements.

These passages of the Laws of Manu are therefore not regarded as conclusive proof of the prevalence of leprosy, but when studied in relation to the Hindu medical writings of a similar period, they afford strong evidence that leprosy was common. There is, however, no evidence of the truth of the assertion recently made in a medical journal in India that in the Laws of Manu, the prophylaxis of leprosy is well described.

#### *Leprosy in ancient China and Japan*

In the literature of ancient China there is little definite evidence of the existence of leprosy. A study of the history of Chinese medicine by Wong and Wu leads to the following conclusions:—

The Chinese medical classic, the *Nei Ching*, attributed by Wong and Wu to the period of 220 B.C. but attributed by tradition to Huang Ti. (2700 to

2600 B.C.), contains four possible references to leprosy under the two names Ta feng and Li feng. None of the four references clearly indicates leprosy although numbness is mentioned in one of them. There is also an ancient tradition that one of Confucius' disciples about 600 B.C. died of leprosy, but here again there can be no certainty. In the third century A.D., there is a description of a disease with numbness which is suggestive of leprosy, but it is not until the seventh century A.D. that fairly definite clinical descriptions of leprosy appeared, and it is stated that the disease was common, one record mentioning six hundred cases treated, and one in ten cured. During this and the succeeding centuries, ostracism of lepers was practised, and in the fifteenth century is made the first mention of treatment of leprosy by chaulmoogra oil, at least 2,000 years after it was used in India. The treatments for leprosy mentioned in old Chinese medical writings include purgatives, diaphoretics and diuretics, arsenic, and snake and scorpion venoms.

In Japan, according to the Japanese writers Tashiro (1905), Kitasato (1910) and Mitsuda (1924) leprosy is described in the literature of the eighth and ninth centuries A.D. Japanese medicine seems to have been much influenced, if not dominated, by Chinese medicine. It appears that there is little foundation for the statement made in the textbook of tropical medicine mentioned above, that 'In Japan it (leprosy) seems to have been recorded first in 1250 B.C.'. This is probably a copyist's error. Newman gives the date 1250 A.D. for Japan.

#### *Leprosy in Biblical writings*

The whole question of leprosy in Biblical writings has been discussed by many authors, and the matter can be discussed only briefly here. Writers of the Middle Ages and later mostly assumed that the *zaraath* of the Old Testament and *lepra* of the New Testament were leprosy as it was known in the Middle Ages and as it is known to-day. Some recent writers have however challenged this view and there has been much discussion on this point. Lie (1938) discusses the matter well. Among his many interesting points one is that 'Zaraath', even if it included leprosy, could only have covered the 'maculo-anæsthetic' variety of leprosy, and that nowhere in the Bible is there any mention of the 'nodular' form of the disease which looms so large in the ancient literature of leprosy.

Lie (1938a) concludes that a study of the Bible does not prove that leprosy existed among the ancient Jews but since the Jews spent a long time in Egypt 'which certainly must have been infected with leprosy' he finds it difficult to believe that leprosy was not found among the Jews.

To this brief discussion of the subject about which there has been much controversy, I will add only a few remarks. As we see later there is no conclusive proof of the presence of leprosy in ancient Egypt, although it was possibly and even probably prevalent. According to various authors, Manetho is quoted by Josephus (De Antiquitate Judæorum) as recording 90,000 cases of leprosy among the Jews, an incredibly high number for true leprosy.

Finally, nowhere in the Bible is there any clinical description corresponding to leprosy as we know it to-day, no mention of numbness and loss of skin sensation, or of the manifestations of leprosy of the 'nodular' type such as are found in the ancient literature of India and of some other countries. The 1942 edition of the standard textbook on tropical diseases states 'in Leviticus 13 and 14, truly remarkable passages regarding the diagnosis and prevention of leprosy are to be found'. The passages are remarkable but they do not describe leprosy.\* In Leviticus 13 the chief criterion for a diagnosis of leprosy is whiteness of patches of the skin and more particularly of the hair on the patches. Such patients are to be isolated indefinitely. Now leprosy patches are not white, and, most important, the hair is not white. This whitening of the hair in white patches of the skin is very suggestive and almost diagnostic of leucoderma. Moreover, the patches of leprosy are only partly depigmented; but verse 38 says that if a person has patches which are dull white, he is clean, that is, not suffering from leprosy, and need not be isolated.

It appears therefore that the 'leprosy' of Leviticus 13 was not our leprosy, and was much more probably leucoderma; but leprosy may have been found and may even have been common among the Jews.

#### *Leprosy in ancient Egypt*

In the literature of the last seventy years there are numerous references to leprosy as being mentioned and described in ancient Egyptian writings. Munro writing in 1876 mentions an Egyptian record of the time of Ramesis II about 1350 B.C., describing the occurrence of leprosy among the Negro slaves from the Sudan and Dafur. This record is also mentioned by Rogers and Muir although they state that its authenticity is disputed. Newman, writing in 1895, goes even further back and states without any reference that 'it existed in Egypt in the reign of Husapti at least 3000 years B.C.'. The recent textbook above mentioned gives the date as 4600 B.C. It has repeatedly been said that leprosy (like many other diseases!) is described under the term *Uchedu* in the Ebers papyrus written about 1550 B.C. Sauton writing in 1901 recorded the existence, in the Cairo Museum, of stone statues belonging to the early dynasties of the Pharaohs, which showed typical leprosy mutilations. Engel Bey reported in 1890 (published in 1893) that the Berlin papyrus contained a treatise on leprosy of a very early period, that is of about the time of the fifth Pharaoh. This is a selection of statements that have been made by different writers at different times. Others could be quoted.

\* They describe skin diseases and, from the administrative point of view, divide the patients into three classes: those to be isolated indefinitely, those to be isolated for seven days at a time; and those not needing isolation. If our leprosy appears at all, it is in the last group!



A critical examination of these records, however, makes it exceedingly doubtful whether a single one is authentic. Engel Bey, who worked for many years in Egypt in close touch with Egyptologists, wrote in 1903 correcting his earlier statements that the Berlin papyrus mentions leprosy, and said that no particulars of the symptoms of the disease are given. He reported a fruitless search to discover the statues showing leprous mutilations said by Sauton to be in the Cairo Museum. He did not produce any definite record of leprosy in ancient Egyptian writings or monuments, although he stated, on what grounds it is not clear, that leprosy existed in Egypt long before the Christian era.

Ebbel (1935) has made a study of the subject including particularly the Ebers papyrus. He finds that the disease described under the name of *Uchedu* does not correspond with leprosy, and he thinks that the translation of this word as leprosy is wrong. He states however that in another part of the same papyrus, leprosy is described under the name 'Chons' swelling'. The passage he cites indicates that this is mainly an affection of limbs. The present writer finds that the identification of leprosy with either *Uchedu* or 'Chons' swelling' is unsatisfactory, the distinguishing features of leprosy not even being mentioned.

Unless more recent work has produced new evidence, it appears that we have no definite proof that leprosy was common or even known in ancient Egypt. We have to come to far later times for the first definite reference to leprosy in Egypt.

#### *Leprosy in royal persons in Europe in the Middle Ages*

It is frequently stated that Robert the Bruce suffered from and died of leprosy, but it is by no means certain that he did. Both Simpson (1841; 1842) and McArthur (1926) studied the historical documents but arrived at opposite conclusions. During their lives or shortly afterwards, reports were made that Henry III and Henry IV of England suffered from leprosy, but, as McArthur has pointed out, statements of this kind made by personal enemies are of no historical value. Simpson, however, rightly said that these reports at any rate clearly indicate that in the Middle Ages, leprosy was not considered incompatible with the highest rank and wealth, and we have authentic records of leprosy in such persons.

Possibly the best authenticated case is that of King Baldwin the Fourth of Jerusalem who was related to the Kings of England. Jeanselme gives interesting abstracts from historians of the period, who describe in detail how Baldwin when a child developed anæsthesia of the limbs, and how by the age of 23 he had become blind, and his hands and feet had become crippled, mutilated, and putrescent. He resigned his kingly powers and shortly afterwards died.

#### *Leprosy in medieval Europe*

Medieval medical writings leave no room for doubt that the true leprosy of the Middle Ages was our leprosy of to-day.

Again and again during the last hundred years the statement has been made that the number of leper-houses in Christian Europe in the Middle Ages was 19,000, and this statement once more appears in the latest book on tropical medicine mentioned above. This statement possibly originated from Hensler's writings in 1790, and it appears to be based on a quotation from Matthew Paris. (Matthew Paris was a chronicler who lived from 1200 to 1259 and was, according to Green, the last and the greatest of the monastic historians of England.) In 1903 Pernet stated that as early as 1819 it was pointed out, by an unknown writer on leprosy in Rees' Encyclopædia, that the statement was based on a mistranslation of a passage in Matthew Paris' 'History of the English up to 1244'. The original Latin sentence runs as follows:—'*Habent nisuper Templari in Christianitate novem millia maneriorum, Hospitalarii vero novem decim*'. This sentence apparently means that the Knights Templars in Christendom held 9,000 manors and Knights Hospitallers 19,000 (the second 'millia' being understood). The word for manor seems to have been translated as leper-house, with no justification. It is true that the Knights Hospitallers (or the Knights of St. Lazarus) administered many of the leper-houses in Europe, and that the order existed for this purpose, but this does not justify the statement that there were 19,000 leper-houses. Ehlers (1903), however, pointed out that the number of leper-houses was probably not much smaller than the number of manors, since many if not most manors would include a leper-house; that in the thirteenth century, 3,000 of the leper-houses in Europe were under the 'commanderie magistrale' of Boigny, the headquarters of the Order of Knights Hospitallers; that at the time of St. Louis there were officially recorded 1,502 leper-houses in France and there were probably others also; and that even in 1693 when leprosy had practically disappeared, the order for the closure of the leper-houses in France affected 1,133 establishments the income of which was thereafter devoted to other charitable purposes.

Virchow (1860; 1861), as quoted by Rogers and Muir, recorded that there were 636 leper-houses in Italy, Verdun, and Maestricht. Newman gave a list of 200 leper-houses in England and Wales alone, and stated that it was incomplete, as it undoubtedly was. Pooth (1939) traced records of nineteen leper-houses within one small area of Eastern Germany which to-day has a population of only 150,000 and was then much less thickly populated.

The standard English book on leprosy is by Rogers and Muir (1940), who in their historical section are in general soundly sceptical, but who in their last edition appear to have adopted perhaps rather an excess of scepticism



regarding the number of leper-houses and the prevalence of leprosy. They state for example that the number 2,000 often quoted for leper-houses in France 'has been discredited by Jeanselme', but a study of Jeanselme's (1934) big work on leprosy does not bear this out. Jeanselme himself gives a list of over 900 leper-houses in France, and this list makes no claim to completeness and applies only to certain parts of France.

Rogers and Muir (*loc. cit.*) also quote the estimate of Creighton (1891) of the extent of leprosy in England in the Middle Ages at its worst period: 'There might have been a leper in a village here and there, one or two in a market town, a dozen or more in a city, a score or so in a whole diocese. Thus in the records of the city of Gloucester, under the date 20 October 1273, three persons are mentioned by name—a man and two women—as being leprous and as dwelling within the town to the great hurt and prejudice of the inhabitants'.

The same author Creighton (1891) in his 'History of Epidemics in Britain' adopted the attitude that while the existence of leper-houses in England in the Middle Ages cannot be denied, it was attributable not so much to the prevalence of leprosy, as to the misguided piety of the period. He seems to have thought that the high figures often given for the number of leper-houses is attributable mainly to the misguided enthusiasm of romantic historians of modern times, whom he accuses of labelling as leper-house every charitable institution of doubtful nature of which they can find any record in medieval writings.

Creighton's statements appear to be very one-sided. He mentions only the three known lepers living in the town of Gloucester but does not mention the two leper-houses outside the town which according to Bigland's 'History of Gloucester' (quoted by Newman) were founded in the twelfth century under a charter. We know that the population of Gloucester at that time was only about 4,000. We know that the city of Norwich in the fourteenth century with a population of a few thousands (the generally accepted figure is about 7,500) had no less than six leper-houses. It appears that the diocese of Exeter at the beginning of the fourteenth century had 39 leper-houses, for there is still extant (Button, 1890) the will of Thomas Button, Bishop of Exeter, who died in 1307 and left 200 legacies, including legacies to lepers lodged at 39 places in the diocese; this is confirmed by the statement of the executors of this will (Boggis, 1935).

It is interesting to note that Newman's list of the 200 leper-houses in England and Wales includes only one-third of these 39 leper-houses in the diocese of Exeter, but that it does include five or six other leper-houses which were established later in this diocese. It therefore appears that the number of leper-houses in the diocese altogether totalled even more than 39,

and that Newman's list of 200 leper-houses for England and Wales is, for this area, very incomplete and probably for other areas also. It is therefore considered that the number of leper-houses in England has not been exaggerated.

Some writers have expressed the view that not only has the number of leper-houses been exaggerated, but also their size and the extent to which they were actually used for cases of leprosy, and that therefore ideas about the prevalence of leprosy in the Middle Ages in Europe are exaggerated.

As we have seen the number 19,000, often given for the number of leper-houses in Europe in the thirteenth century, is wrong and based on a mis-translation, but it also appears that the number was probably at least several thousands. There is no doubt that most of the leper-houses were small, but we know that some of them had accommodation for over fifty patients, and, although it cannot be quoted fully here, good historical evidence exists for the belief that the leper-houses were used to a considerable extent for genuine cases of leprosy. Even when they were not so used, it was often not because there were no lepers, but because the funds were being misappropriated by kings, barons, local lords and the clergy!

It has often been suggested that inaccurate diagnosis must have led to the committal to leper-houses of persons who were not suffering from leprosy, and this undoubtedly must have occurred. Nevertheless a study of the medieval medical writings on the subject, such as those of Guy de Chauliac (fourteenth century), indicates that the need for care in this matter was realized. This writer describes the unequivocal signs of leprosy which alone justify the diagnosis of leprosy and committal to a leper-house, and it is interesting to note that he wrote as though a diagnosis of leprosy was usually, if not always, followed by such a committal. His unequivocal signs of leprosy however are such as are seen only in what we should call very advanced cases. It is obvious that if this was the criterion for a diagnosis, there must have been very many cases of leprosy outside the leper-houses.

Another matter stressed by a few writers is the frequency with which other diseases such as secondary and tertiary syphilis must have been wrongly diagnosed as leprosy. At a later date this was undoubtedly true, but at the time that leprosy was at its height in Europe and most of the leper-houses were being built, syphilis was either rare or absent from Western Europe. Most historians are in agreement that leprosy was at its height about the thirteenth century but that syphilis did not appear commonly in Western Europe until much later.

Another factor that is often overlooked is the small size of the population of European countries, particularly England, at the time that leprosy was at its height. In England, for example, in the latter part of the fourteenth

century, the total population was probably not more than three millions. Actually the figure generally accepted by historians for the year 1377 is just over 2½ millions. This figure is from calculations based on the figures of the number of persons paying the poll tax of that year. There were in England at that time only 41 towns with more than 1,000 people, only 22 with more than 3,000, only 10 with more than 5,000, and only 3 with more than 10,000, namely London, York and Bristol with 40 thousands, 13 thousands and 12 thousands respectively. This, however, was in the period following the Black Death, which killed, it is said, one-third of the whole population of England and probably a higher proportion of the population of the towns. Nevertheless it is certain that many towns were little more than large villages centred round a castle or an abbey. In spite of their small size, nearly all the towns had one, and some two or more leper-houses, Norwich having no less than six.

There is much more which might be said on the subject. A general consideration of the available literature has led the writer to the view that the prevalence of leprosy in England, and in fact in medieval Europe, was very considerable. Nevertheless there is not adequate historical evidence to justify the impression given by some historians that leprosy affected a large section of the population and became a scourge not much less serious in its way than the Black Death.

In no large area of the world, even under conditions most favourable to leprosy, does the incidence to-day rise much above 5 per cent, and a much more usual incidence is about 1 per cent even in countries which are regarded as being heavily affected. It seems unlikely that the incidence of leprosy in the Middle Ages in Europe was any higher than it is to-day in certain parts of Africa, Asia and South America, and it was possibly much lower, although of course any accurate estimation is out of the question.

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## Medical News

## COW AND GATE MILK FOOD

COW AND GATE MILK FOOD, although a first-class infant food of paramount importance—especially in a country such as India—continues to be classified by the authorities for customs and other purposes under the generic heading of 'Farinaceous and Patent Foods', tariff item no. 19. As such it is treated on the same level as unessential articles such as old newspapers, marble and stone cigars, etc., to mention only a few of the other headings to which the import restrictions apply.

Stocks in the country are almost finished and the public who have been relying upon Cow and Gate Milk Food to safeguard the health and welfare of their infants—the future generation—are bound to be gravely concerned at the stoppage of the supply of such an important item, upon which they have come to place so much reliance. We wish to add and to

emphasize the fact that plentiful supplies of Cow and Gate are available at the Canadian Factories of the Company, waiting to be shipped as soon as import restrictions in India are removed.

## THE FACULTY OF TROPICAL MEDICINE AND HYGIENE, BENGAL

THE following students are declared to have passed the L.T.M. Examination, Session 1942.

## Passed

(Arranged in alphabetical order)

1. Benoy Kumar Banerjee, L.M.F., private practitioner.
2. Romesh Chandra Barua, L.M.P., private practitioner.
3. Saileshchandra Bhattacharyya, L.M.F., private practitioner.

4. Kashi Nath Bondopadhyay, L.M.F., assistant medical officer, Bahipookni Tea Estate, Darrang, Assam.
5. Monoranjan Chakraborty, L.M.F., private practitioner.
6. Amarendra Narayan Choudhury, L.M.F., clinical laboratory assistant, Pabna Sadar Hospital.
7. Amarendra Nath Das Gupta, L.M.F., private practitioner.
8. Bijoy Krishna Ghosh, L.M.F., private practitioner.
9. Mahadeo Prasad Joshi, L.S.M.F., house physician, Chittaranjan Hospital, Calcutta.
10. Charu Chandra Karkoon, L.M.F., medical officer, Mahaluxmi Cotton Mills, Palta, 24-Parganas.
11. Ronjit Kumer Mazumder, L.M.F., private practitioner.
12. Jati Bhusan Ray, L.M.F., medical officer, Viswa Bharati, Sriniketan, Bolpore.
13. Bimal Kanti Roy, L.M.F., private practitioner.
14. Naresh Chandra Sett, L.M.F., private practitioner.
15. Shah Md. Lutfur Rahman, L.M.F., private practitioner.
16. Bhopindar Singh, M.B., B.S. (Punjab), private practitioner.
17. Ram Behari Lal Srivastava, L.M.F., house surgeon, Chittaranjan Hospital, Calcutta.

### BRITAIN'S HEALTH

BRITAIN has been at war for more than a thousand days. What are her gains and losses on the battlefield of health? Has the enemy of mal-nutrition pierced her defences? Has epidemic disease ravaged her towns and cities? Has the strain of long days at the bench or in the field lowered the resistance of her people? Or is Britain standing the strain? The Registrar-General of Births and Deaths has just given the answer, based on figures which none can contest.

The birth rate in 1941 was lower than that for 1939. Indeed, the number of births was the lowest since 1933. But for the first quarter of 1942 the birth rate was the highest recorded in this quarter for the past ten years.

One index of the health of the country's mothers is the number of babies still-born for every one thousand total births. This is called the still-birth rate, and it has fallen steadily since 1939. 1941 shows an improvement on both 1940 and 1939.

#### *The infant death rate*

The infant death rate has risen slightly, although fifty years ago the figure was twice as high as it is to-day. The infant mortality rate in 1941, though slightly higher than in 1940, was no more than that in 1937, and lower than the figure for 1936. It is considerably lower than the average for the years 1931 to 1935.

Once again, the first quarter of this year shows a remarkable improvement. Indeed, the infant death rate in the first quarter of 1942 is the lowest ever recorded in the first quarter of any year.

The general death rate tells its own story. In 1941 it was lower than that in 1940, but somewhat higher than in 1939. But these figures include the violent deaths in England and Wales caused by the war. It was in August 1940 that the Luftwaffe began large-scale air attacks. It was in the third quarter of 1940 that the effect on Britain's death rate became evident. This accounts for the rise in 1940 and for almost all the difference between 1939 and 1941. Excluding all such deaths from violence from the figures, the death rate in 1941 was 11.7 per thousand of the population, compared with 11.5 in 1939 and 12.7 in 1940.

In the first quarter of 1942—and it is in the first quarter of the year that there is always registered a higher death rate than for the year as a whole—the total death rate, even including deaths from violence, was under 15 per thousand, lower than in the first quarters of all three preceding years. This figure does not, of course, cover the fighting Services.

#### *Figures for infectious diseases*

Then consider the Registrar-General's figures for deaths from infectious diseases. Here, there are both

increases and decreases. The most important increases in 1941 were in tuberculosis, whooping cough and the enteric infections.

Tuberculosis has given rise to some anxiety. There was an increase in the number of deaths from lung tuberculosis in 1940 over those in 1939. But there was no further rise in 1941. It was in other forms of tuberculosis, particularly tuberculosis of the coverings of the spinal cord, that a further rise took place.

One explanation of the figures for lung tuberculosis is that the additional stresses of war, both physical and psychological, proved too much for many patients already ill with lung tuberculosis. They died in 1940 or 1941, before they would otherwise have done. Whether there is any new tuberculosis infection abroad in Britain can be judged only when the full figures for 1941 are available.

The position is being watched with care, and the task will be made easier by the use of machines for mass radiography by means of which 200 chests can be photographed in an hour.

To compensate for these increases there were decreases in the deaths from other infectious diseases. Typhoid fever, scarlet fever, erysipelas, late syphilis and, among males, recent syphilis, all show a decrease in the number of deaths.

#### *Fewer people died*

To these infectious conditions may be added some other diseases from which fewer people died in 1941. They include appendicitis, gastritis, infections of child-birth, rheumatic fever and ear and mastoid diseases.

There have been fewer deaths from toxic goitre, from cirrhosis of the liver, and from the toxæmias of pregnancy.

Balancing the increases and the decreases, 1941 was a remarkably healthy year, judging by death rate from diseases. But death is not the only index.

#### *What of general resistance?*

Has there been a serious increase in infectious disease which causes illness and incapacity, but not a fatal issue? The answer is 'no'. Has there been a serious increase in non-infectious diseases of a non-fatal character? Again, no. Are there signs among the children or the grown-ups of mental strain finding expression in neurosis? On the contrary, war has brought a fall in the number of neurotics seeking treatment from doctors and clinics. People are too busy to permit themselves the luxury of a nervous breakdown.

Lastly, are there signs of malnutrition? Are there, in the streets of Britain's cities, and the lanes of her countryside, children who look pallid, listless and weary? Are there signs of vitamin shortage? For instance, has the disease of scurvy, due to shortage of vitamin C, appeared as it did in some areas in the first world war? The answer is a plain and unqualified 'no'.

It is friends overseas, the seamen of all free nations, and Britain's own farmers and other workers who have secured a food supply sufficient for all the country's basic needs. There are no signs of malnutrition. Lord Woolton has reorganized British dietary, but not to the detriment of health. Britain is as fit as she has ever been—and the figures prove it.

CHARLES HILL, M.D.

### THE ANTISEPTIC

WE have received a copy of *The Antiseptic* for October 1942; it is a special number on 'war medicine and surgery'. The decision to bring out such a number is a wise one in view of the present situation. There are in this volume thirteen articles by different contributors. Most of them (on war injuries, burns, etc.) are of practical nature. The article on typhus by Professors Heilig and Naidu will be read with interest and their classification will be helpful. Medical practitioners will appreciate this volume by having this opportunity of reading these articles in a concise form.

## Public Health Section

### PUBLIC HEALTH ORGANIZATION

#### IV. PUBLIC HEALTH ENGINEERING

By K. SUBRAHMANYAN, B.E. (Madras),

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PUBLIC health engineering is a modern idea of very recent origin. The public health engineer used to be known as the sanitary engineer, and is still described as such in many countries.

The new designation represents a gradual change of concepts regarding the scope, functions and training of the person responsible for the public works relating to environmental hygiene.

Forty years ago, the sanitary engineer was not a specialist. He was an ordinary civil engineer, engaged on the construction and maintenance of water-works, drainage works, and sewerage projects. He was well versed in hydraulics. He could build a dam or reservoir, and lay pipes and sewers. He knew a little bit of plumbing, but was not so sure of his ground in the installation of pumps and engines. He felt equally competent to construct irrigation works, water-works, or land drainage works, because the applications of hydraulics were involved in all these. As regards water purification or sewage treatment, he knew a few thumb rules, and had some inflexible notions; but he was ignorant of the complex physico-chemical, biological and bacteriological processes involved in modern water purification and sewage treatment. Regarding health and disease, the origin and progress of epidemics, biology, physiology and ecology, he knew nothing. His service to society was through constructive work on dead or inert material, such as concrete and steel, not living material.

Those concepts have been modified during the last twenty years. Public health has been recognized as one of the important functions of governments all over the world during the last two decades, and health programmes have been initiated or intensified everywhere. The assistance of the sanitary engineer has been sought for carrying out these programmes. He has been required to draw up schemes for water-supplies and sewerage for innumerable villages, towns and institutions; and to treat water and sewage of urban communities as in refined industrial processes. He has had to devise methods of collection and disposal of refuse and garbage. He has been called upon to clear slums, plan townships, improve ventilation and lighting under a variety of conditions ranging from the rural hut to the mammoth factory,

abate nuisances from smoke, dust, noise, etc., and make living conditions comfortable. His services have been requisitioned for extermination and control of pests, bugs, rats, flies, fleas, lice, anopheline and other mosquitoes, etc., in public health measures for the control of plague, typhus, malaria, yellow fever, etc. He has been required to watch the pollution of natural streams and harbours and estuaries by community wastes and industrial wastes, and safeguard the purity of natural waters. He has been required to take care of environmental conditions so as to ensure the purity and wholesomeness of milk and dairy products, food, vegetables, fruits, fish, shell-fish, and meat, all the way from production through handling, transport and marketing down to consumption. Increasing attention is being paid to rural public health, and the old sanitary engineer has been asked to put forth practical ideas suitable for the limited resources of villages, for water-supplies, for refuse disposal, for the prevention of soil pollution, for schools, dairies, markets and many other things. The public health engineer's duties have become manifold. He has to advise the villager on the construction of cheap latrines, the factory manager on the disposal of his trade waste, the theatre owner on measures of safety and ventilation and air-conditioning. He has to look after the fumigation of grains at a port, or carry out subsoil drainage in a malarial region. The demands upon his services call for great skill, broad education, erudition, tact and social aims. He is required to render social service in a less spectacular but much more intimate way than his colleague who builds bridges and roads and factories. He has to co-operate with the health officer in practical measures to carry out health ideals.

The modern public health engineer has to be fundamentally an engineer, i.e. one with a practical outlook, imbued with a sense of realities and economy, clear-cut ideas and methods, and capacity for organization and execution. He must be well educated in all the basic sciences pertaining to his profession, such as strength of materials and theory of structures, mechanics, physics and chemistry and bio-chemistry, hydraulics and surveying, geology, physiology and biology, construction, estimating and specifications, and in public health subjects. Unless he is well trained in public health subjects, he will not be in a position to appreciate and assist the medical officer of health who will be his colleague and critic. Instead of thinking out for himself he will be reduced to the position of constantly taking orders from his colleague who will not know practical details. It will be an irksome position for both.

The public health engineer has been suddenly called upon to meet these multifarious demands, and has been evolving under some handicaps,

The orthodox civil engineer did not usually get any training in public health and allied sciences, such as bacteriology, biology, physiology, epidemiology, etc. When an engineer ignorant of these things took up public health engineering, he did not command even scanty respect from his colleague, the medical officer of health. An antagonism developed between the two, instead of mutual confidence and respect. This antagonism was specially noticeable in the field of malaria control some years ago. Medical men used to write books on malaria, referring to the engineer as a blunderbuss scattering malaria in his wake, a public enemy digging borrow-pits along his railroads and highways, and sowing the seeds of malaria in the places where he stepped in for irrigation or power projects. When medical experts on malaria referred to man-made malaria, they had only one man in view, the engineer. That antagonism has since vanished. It is true that the engineer committed a lot of mistakes owing to his ignorance of the causation of malaria and the life and habits of the malarial mosquito. But when he was educated in these matters, the engineer became a valuable ally to the health officer in the control of malaria. It is now realized that malarial engineering is a highly specialized form of work that medical men cannot do by themselves. With understanding and co-operation between the medical man and the malarial engineer, intricate schemes of drainage, subsoil drainage, filling, flushing, adult spray-killing and naturalistic measures of control are now carried out more efficiently and expeditiously than before.

Another handicap under which the public health engineer has evolved is the prejudice of the old classical engineers, against one who is engaged on such humble work as designing latrines and cattlesheds. This is unreasonable and stupid, like every other prejudice, and has not yet disappeared completely. It used to keep away ambitious young men from the humble fold of 'stink experts' who have developed into public health engineers now.

The greatest handicap, however, has been the lack of facilities for special training in public health engineering for engineers. The multifariousness of their duties, and the versatility required to discharge those duties efficiently, have already been indicated above.

There are no post-graduate courses in Indian engineering colleges in public health engineering. In the undergraduate courses leading to a degree in civil engineering of the Madras, Calcutta, Bombay and Mysore universities, sanitary or public health engineering is taught as applied hydraulics. Water-supply and purification and sewerage and sewage disposal are taught, more from the point of view of structural design than from the point of view of public health. These subjects take up only a small part of the student's time, when he prepares for a general degree in civil engineering.

In England, London and Manchester universities offer courses in municipal engineering, covering the commoner phases of urban sanitation.

In the United States of America, many universities offer under-graduate courses in sanitary or public health engineering leading to a degree distinct from, or as major courses of study under, civil engineering. Such universities are well distributed all over the States. The courses are not stereotyped. Besides, there are some universities offering post-graduate courses leading to degrees in sanitary or public health engineering. Harvard has a wide and comprehensive course with excellent laboratory facilities and field inspections, with perhaps slight over-emphasis on the theoretical side. Most of the state sanitary engineers are sent to Harvard for training. Chapel Hill, the Massachusetts Institute of Technology, Columbia, the Carnegie Institute of Technology, Pittsburgh University and Michigan are also offering good courses.

The modern public health engineer has not only to be well read and cultured; he must express himself elegantly on the platform and through the press. He has to sell his ideas to the public. He has to educate them, convince them, and ask them to put up funds for his projects. He is thus coming more and more into the limelight. Health work is expensive, and funds have to come from several sources, some of which may be voluntary, some from private and philanthropic sources, and some from municipalities, governments, etc. The health engineer has to convince all these sources about the soundness and urgency of his projects. In some cases he is asked to spend the allotment himself. More often he is called in as consultant. As such, he has to draw up alternative schemes to suit the resources of his clients. The schemes that he executes personally are only a tiny fraction of those that he draws up or expresses an opinion upon.

Sometimes his schemes are given to engineers of the public works department to execute, as he may not have the time, staff, or tools and plant to carry them out. In his capacity as consultant he has to use tact and avoid harsh criticism of other engineers executing his ideas. Unrestrained criticism may produce hostile reactions.

In India the position of the public health engineer to-day is beset with difficulties. The funds for works are mostly from Government or under their control, and have to be spent according to rigid plans and procedure. If the health engineer is directly responsible for the execution of works, he has to cut down consulting work to a minimum, for want of time and staff. He is placed between the health and the public works departments, and tries to maintain harmonious relations with both and with local bodies. If his duties are mainly executive, he is attached to the public works department, to give him the benefit of tools, plant, uniformity

of procedure in accounts, etc. This appears to be the case in Madras. If his work is mainly that of consultant to the health department and local bodies, it is better to have him attached to the health department for administrative purposes. This is the position in most state health departments in the United States of America, and in Ceylon. It fits into the organization outlined by Dr. Jacocks in his introductory paper to this series on Public Health Organization.

Considering the amount of work that lies ahead, the number of public health engineers in India is too small. There must be competent and qualified health engineers in every municipality, besides regional health engineers. There is plenty of work before them, whether they are administratively under the health department or under the public works department of Government. Barely 4.5 per cent of the population of India enjoy the benefits of protected water-supply. Our villages and towns lack the most elementary sanitary amenities. Our public health engineers have to prepare planned programmes for water-supply, drainage, latrine construction and malaria control in the rural areas where so many millions of our people live. The water resources of the country have to be located and surveyed. The schemes must be within the financial resources of the rural population. They must be classified according to urgency, and carried out according to timetable.

For the requirements of India, the teaching of public health engineering as a small part of civil engineering is inadequate. The four-year curriculum is already overburdened, and it is not advisable to enlarge the syllabus in this branch alone in the under-graduate course, before the student has had time to decide which branch of civil engineering he will practice. Hence it is necessary to introduce public health engineering as a subject for post-graduate study leading to a degree such as Master or Bachelor in Public Health Engineering. The course must be of at least one year's duration and must include water-supply and purification, sewerage and sewage disposal, sanitary chemistry, ventilation, housing, industrial hygiene, malarial engineering, bacteriology, biology in relation to public health, epidemiology and statistics. These subjects must be taught with equal emphasis on the engineering and health aspects. The courses must fulfil the duty of a university; which is to prepare students for the most diverse post-graduate activities and equip them for continuing their own education in life unaided by class-room instruction. It must not aim merely to produce good craftsmen. Such courses can be planned at the existing engineering colleges of Calcutta, Madras, Bombay, and Mysore, with the collaboration of the All-India Institute of Hygiene, the public health and medical departments of Madras, Bengal and

(Concluded at foot of next column)

## PREVENTIVE PÆDIATRICS :

### AN ACCOUNT OF HEALTH WORK IN TRENGGANU, MALAYA

(Continued from September issue, p. 552)

#### THE SCHEME FOR HEALTH WORK

By J. W. SCHARFF

##### PART I

THE object stated in the terms of my assignment to Trengganu was the duty of carrying out a 'health survey' within a period of six months.

(Continued from previous column)

Bombay, and the Indian Institute of Science, Bangalore. Besides these, specialized instruction in a particular branch, like malarial engineering, can be given by the All-India Institute of Hygiene. The students for such post-graduate courses must be men who have already decided to take up public health engineering as their career, i.e. graduates in engineering who have taken up municipal engineering or service in the local boards, or who have worked for a year as apprentices to sanitary engineers.

The public health engineering division for a state or province may consist of a chief with three or four assistants at headquarters and the necessary number of district engineers in the field. The assistants at headquarters may have functional instead of regional jurisdiction, so that each assistant may have a chance of specializing in a particular field of work. There must be a workshop and a laboratory at headquarters, besides an efficient drawing office. The district engineers must be in a position to undertake surveys, to collect data, and to carry out works. The staff at headquarters must be in a position to give expert advice, carry out research, and evolve standards.

If the present district board engineers and municipal engineers are relieved of some of their routine work in connection with the maintenance of roads, they can devote time and attention to public health engineering after receiving specialized post-graduate instruction.

If this idea finds favour, promotion to the higher grade among local board engineers and municipal engineers must depend among other things on their qualifying in public health engineering. The pay and prospects of such qualified engineers must in general be better than those of ordinary public works engineers.

##### Summary

The evolution of the modern public health engineer from the sanitary engineer is outlined. His functions, qualifications, handicaps and opportunities are described. His position in public health organization is discussed, and the work awaiting him in India is pointed out. A scheme is outlined for post-graduate instruction in public health engineering, in India.



It is generally assumed that a health survey implies an investigation into the causes of ill-health, followed by a report, upon which action may or may not be taken at a later date.

There have been many surveys, but few have led to an attack on the fundamental causes of disease, already so well known. Consequently my design, to avoid such a lamentable ending, was to originate a scheme in place of an inquiry, to try out certain of the most obviously necessary and acceptable health procedures and policies which might be followed up with benefit in the future.

It was my purpose to show that the state of Trengganu could cope with its own health problems within the orbit of its existing organization and that local initiative and local labour, coupled with the proper use of local materials, could and should become the mainstay of public health and progress.

Abundant information, both in Trengganu and elsewhere in Malaya, led to the conclusion that there were three important avenues to health, which offered almost unlimited and unrivalled opportunities to benefit a rural population depressed and victimized by the stranglehold of sickness. These avenues were better feeding, malaria prevention and infant welfare.

The first and foremost of these objectives was improved nutrition but without improved sanitation the mere betterment of the food supply would be of small avail to a community infested with intestinal worms and other filth diseases. Thus a scheme of improved sanitation, though discussed under a separate heading in these notes, had improved nutrition as its background and was linked with an effort to foster agriculture and animal husbandry. These twin objectives should never be torn apart in any programme of rural uplift. Next comes a brief account of what has been newly attempted in the prevention of malaria; and lastly a more detailed discussion on infant and maternal care. In this closing section, my close collaboration with Dr. Williams renders us both almost equally responsible for what is recorded on this item of our work.

#### *Improved nutrition*

The factor most generally associated in Trengganu with the problem of ill-health, and, in particular, with a high infant mortality was the habit of eating polished rice. This habit is partly accounted for by the fact that polished rice keeps longer. Therefore the shopkeepers find it more profitable, if they can sell it to an unsuspecting population. It was clear that this unfortunate preference for the white polished product should be one of our chief targets for attack. The health giving quality of under-milled rice was stressed by constant demonstration at welfare centres and in schools. It was shown how, by correct cooking, the unpolished rice could be most appetizing as well as wholesome. Thanks to the support of all concerned a rice mill, which had been set up in the town, was made to produce

under-milled rice as an experiment. The public and the shopkeepers were fully persuaded, the Malay rulers and their people gave a fine response. The experiment has been successful. There is now a vigorous and growing demand for under-milled rice, which has greatly helped to bring about a reduction in ill-health.

#### *Home gardening*

The lack of vitamin in rice was not the only nutritional defect which lent itself to prompt and successful action. The obvious need for increasing the production and consumption of home-grown vegetables and fruit was another direction in which rapid progress could be made. Interest was soon aroused in the growing of many useful leafy vegetables and fruits, such as papaya, in gardens and allotments.

#### *Compost making*

The secret of success in gardening depends upon the making and maintenance of soil fertility. If more vegetables are to be eaten, more must be planted and if a larger total area of vegetable gardens is to be cultivated successfully, more manure must be used.

Trengganu is now well ahead in the solving of this problem which is concerned in the production of kampong and village compost. Developing along these lines many of the townsfolk and villagers are now pulling their weight in this campaign of digging for health and victory.

#### *Town and village sanitation*

The necessity for clean surroundings increases in proportion to the growth and concentration of a population. Consequently the major problem of sanitation was concerned with the larger villages and towns. Schemes to improve scavenging and conservancy have been put in hand. Wherever practicable, bore-hole latrines have been introduced and scavenging gangs organized to meet local needs.

#### *Anti-malaria measures*

Whereas better nutrition and improved nurture have almost universal application, malaria control measures need only be regarded as a primary essential in places where this disease overshadows the other health problems of a community. These are the places where the people are repeatedly struck down by epidemic visitations of malaria or where the inhabitants are so saturated by continual infection that the vicious cycle of ill-health and incapacity can only be reversed by severing the chain of malaria incidence at the point where it is the most vulnerable to attack.

In Trengganu one is set the task of applying the methods of malaria prevention which will suit an unusually backward and impoverished people. A beginning has been made, for the first time, in the application on a large scale, of what has been described as 'naturalistic' measures of malaria control. This is a course of action first made known to science by Professor

Williamson, a former Professor of Biology at the College of Medicine in Singapore.

The effect of this work in a number of villages controlled, has been sufficiently encouraging to ensure a further extension of these works and to compel more investigation along these lines of progress.

## PART II

By CICELY D. WILLIAMS

### *Scheme for health work*

Welfare work { Development of maternity and child welfare.  
Permeation of medical work with preventive.

#### (a) General

THIS section is an attempt to explain the relations of welfare work.

The original function of the state medical service in the dependencies was to provide medical attention for the individual, to begin with mostly members of the European staff. As time went on there was more demand for treatment by non-Europeans and by the general public. Also the 'Preventive' function of the medical department was developed, and means for combating the spread of epidemic diseases were enforced by the government medical service.

It is now being gradually realized that just to prevent the spread of epidemics is a negative function of limited usefulness; that a healthy population is essential to the state; that health depends on housing, nutrition and education, not merely on the prevention of epidemics, and that the function of the medical service is to raise the standards of living and of health.

Now, in Malaya, medical attention for the individual is provided by dispensaries and hospitals and bedside nursing, for all of which there is considerable provision, as well as for the training of personnel, doctors, nurses and dressers.

For the impersonal side of preventive work, port health, sanitation, malaria control, plague and smallpox prevention there is again considerable provision and training for personnel, i.e. a school of training for sanitary inspectors.

As a whole the outlay on buildings and equipment has been large compared with the amount spent on training.

But for the third and newer aspects of health work, welfare, health education, the personal side of preventive medicine, nutrition, social services, and all the ancillary departments which perform such an important (though sadly disintegrated) part of medical services there is as yet little in the way of planning or training for personnel and regrettably little awareness of the need for these things.

Now in a comparatively backward country this aspect of medicine has a special importance which is far beyond that in a 'civilized' state. In a civilized community there is a multitude of

organizations, like the boy scouts, women's institutes, cinemas, newspapers, extension lectures, workers' guides, etc., etc., which largely help to form public opinion and to give popular instruction and assistance. But in a backward country there is the major part of the population that never comes in contact with the medical service either in its preventive or in its curative capacity or else comes in contact with it so very slightly as not to count. This section has none of the health knowledge that is taken for granted in a civilized community, in fact it looks upon many of our basic health measures as incomprehensible extravagances. Secondly, malnutrition and preventable diseases, apart from major epidemic diseases, form the most important factors in the health landscape, and thirdly, it is through work of this sort that a backward population could most easily and most profitably be reached.

The medical service in the colonies and dependencies should therefore devote a great deal of attention to teaching, both for the members of its staff and for the general public. In fact it may be said that education is the chief function of medicine.

The rationale of welfare work is often neglected. The result is that in some countries it has proved disappointing. Welfare centres of the pattern forged in Europe, whetted in America and burnished in the Antipodes have been established without first consulting the conditions and needs of locality.

In a country such as Trengganu, setting up a welfare centre of the orthodox pattern would be no more good for the health of the people than setting up Fortnum and Mason would be for their nutrition.

Orthodox welfare centres, that claim to prevent disease but not to cure it, were introduced in Britain to fill gaps in health work in a country that already had an established and acceptable hospital system. In spite of many limitations their success has been enormous. There are only a few people who are in a position to appreciate this success. Dr. Eric Pritchard, writing in November 1940, compares the modern welfare child with the old pre-welfare child as 'Hyperion to a Satyr'. He says 'infant mortality and morbidity are mainly a matter of maternal ignorance, and infant well-being and health a matter of education'. In saying this he acknowledges that welfare work is merely the specialized channel through which improvements in education, nutrition, housing, industrial hygiene, etc., have been brought to bear on the condition of infants and children. It is a type of work that has none of the dramatic appeal of surgery, or of biochemical discoveries, but in its way it is probably even more life saving.

But nowadays even in the West it is being increasingly realized that in work with children, prevention and cure must go hand in hand or both are comparatively useless. It is futile to imagine that there is always a clear distinction between a sick and well child. In order to

prevent disease it is essential to have a sound knowledge of the diseases one means to prevent. There can be no rational excuse for putting a child with a deficiency disease into one hospital, and for the pneumonia which is secondary to that deficiency into another.

There are three separate tendencies now to be seen in England and America. One is that nurses undergoing a '*General training*' do not only study bedside nursing. A great many of them are going to be employed in non-institutional activities. It is found to be impossible to understand the significance of illness unless wellness is also studied. Welfare and environmental hygiene form an essential part of general nursing. Another tendency is to avoid the present overlapping in the various welfare services. Instead of one family being visited by school nurse, factory nurse, T.B. nurse, hospital almoner, etc., it is preferable as far as possible to replace all these visitors by one polyvalent worker, more on the lines of the '*familienfursorge*' of central Europe. The third tendency is to give a training to these workers that is both clinical and preventive, that will fit them for their polyvalent function without the necessity for going through a whole series of isolated diplomas.

In starting welfare work in a country such as Trengganu, it must be remembered that the system must be a comprehensive one. In fact, it should be built on the 1950 model rather than on the 1900.

There are serious difficulties which have stood in the way of the development of welfare work in the dependencies. In the first place, many of those who are responsible for it have only been acquainted with welfare centres of the old-fashioned British type, and they do not conceive of any other. The second difficulty is the complement of the first. No doctor who has had first-hand experience of welfare work has ever yet been appointed to a senior position in the government service.

The welfare doctor's difficulties have not only been administrative, they have been professional as well. At its best the work must be both preventive and curative. But its preventive aspect is intensely personal. In some places it has happened that a welfare doctor who has attempted to investigate or to treat efficiently disease that she has been told to prevent, has been accused of 'treachery to preventive medicine'. On the other hand, a clinician who attempts to take an interest in preventive medicine is regarded with dark suspicion, and in fact is looked upon as not being a clinician at all. The results of all this is that co-ordination of preventive and curative work has been unsatisfactory. Much time and effort and money have been wasted. Four-hourly feeds and water in between are diligently recommended for babies that are dying of beri-beri and rickets, while thousands of pounds are spent yearly in hospitals and dispensaries in curing diseases that are perfectly preventable.

The third great handicap is one that has already been mentioned, the lack of a training school for health workers, so that one is faced with a double problem, of training a staff and working out a project at the same time. The problem of staff is an acute one, but local problems should guide us in the choice and training of staff. Local needs and local abilities should be the starting point, although the standard to be aimed at is a high degree of attainment.

In order to conduct welfare work in Trengganu with economy and efficiency it is necessary to bear all these arguments in mind. We can now summarize our consideration:—

(1) It is most essential to begin with a study of local conditions and of local diseases.

(2) It is necessary to consider economy, local needs and local abilities when devising methods of control.

(3) Prevention and cure must go hand in hand or both are relatively useless.

(4) Both prevention and cure must be accompanied by tireless explanation, encouragement and health teaching.

(5) Teaching must always be vigorous, idiomatic and direct. Teaching that is mechanical and perfunctory does actual harm by producing an immunity.

(6) It is relatively useless and uneconomic to concentrate on 'infant' welfare. All the family and household, and all the domestic and social and economic factors must be taken into consideration, must be cherished and educated. To attend to the infant to the exclusion of all other elements in the domestic scene is to fail to realize the surpassing importance of environment than the human infant.

(7) In introducing nutritional improvements it is essential to utilize what is available, what needs least preparation, least cash expenditure, least disorganization. To improve artificial feeding of infants would do a little good to a very small number of infants. To encourage breast feeding, to improve the technique of breast feeding would do a very great deal of good to a very large number of infants.

(8) Local customs are legion. In the past there has been a great tendency to 'let the Malays keep their customs'. To accept this policy without criticism is to destroy the race. It is necessary for educators of every description, particularly health workers, to encourage the people to examine their own customs, and keep those that are beneficial or harmless, and to destroy ruthlessly all those that are damaging to domestic and to child life.

(9) Hospital and welfare work should as far as possible be covered by the same staff and the same direction. They must be co-ordinated throughout so as to ensure continuity of treatment, of advice and of record keeping. The mother whose child has been successfully treated in hospital is more ready to follow advice from the welfare centre if she comes in

contact with the same staff. The mother who has grown to know and trust the welfare staff is more likely to seek hospital treatment for her child's illness if she knows that in hospital it will be cared for by the same individuals.

(10) The staff must be given variety of work or they invariably become stale and mechanical. Too much home visiting is exhausting and monotonous; too much sitting in clinics and handing out advice and treatment is exhausting and monotonous; too much working in hospitals is exhausting and monotonous; but let each individual concerned have work that is varied between hospitals, home visiting and welfare centres and at once there is variety of occupation, there is the interest of watching individuals through health and sickness, there is a more comprehensive attitude towards cause and effect. These are factors that have a strong influence in developing the characters of the staff, as well as their interest and efficiency.

(11) We cannot afford, nor could we obtain, a complete trained staff with which to set up the work. We have to discover local talent and make use of local abilities as we go. Bidans, midwives, nurses, and helpers of all sorts are wanted. By exploring and training and testing and teaching we will gradually manufacture our staff.

(12) Adequate supervision must at all times be maintained. Supervision means co-operation and discussion as well as inspection. For the welfare worker it is disheartening to see many cases without opportunity for discussing their progress and their special interest with the doctor. For the junior worker it is essential to spend a considerable part of the time working with those who are more experienced. For the doctor it is a great advantage to be able to obtain the co-operation of the health workers, an advantage which many of them have not yet learned to appreciate.

(13) The work itself is never static. It is always exploring and developing. It is a good thing for all workers to have too much to do, than instead of merely directing the work they are also directed by it. It sometimes develops surprisingly.

(14) Co-operation with the education, the agricultural, administrative and other departments is essential.

#### (b) *Establishment of clinics*

Before deciding on the set up of the centres themselves, it is necessary to keep in mind some detailed considerations as well as the foregoing general principles :—

(1) The mother who has the enterprise, who has taken the trouble to come to the clinic with her child is in a more receptive state of mind and more willing to follow advice than the one who is visited willy-nilly in the home. Therefore attendance at clinics must be encouraged.

(2) It is impossible for the women to spare time to go any long distance to a welfare centre.

The centres therefore must be sufficiently numerous to be readily accessible.

(3) Sickness and death among children is taken very much as a matter of course. Sickness in a child will not force the family through economic necessity to take the patient into hospital, as it may in an adult. Treatment for children therefore must also be readily accessible if the people are to avail themselves of it, particularly in the early stages of the work.

(4) In the clinics there is a spirit of friendly rivalry and mutual education which is lacking in home visits.

(5) One worker can supervise a very much larger number of cases if they attend clinics than if she has to visit individuals in the homes. (The orthodox system gives each health visitor a district with 250 births per year. There were 3,400 births registered in the Kuala Trengganu district in 1940.)

(6) It is unreasonable to expect people instinctively to know the value of preventive medicine, but if they see the results of effective treatment and their confidence is won, then they readily continue to attend and to follow advice. Therefore efficient treatment must be given in case of illness, not mere placebos—particularly in the early stages when people are still shy of hospitals and before they realize the necessity for keeping an apparently healthy child under supervision. In places where the people are educated sufficiently to attend hospitals when advised to do so, it may be necessary only to keep a few simple drugs. But in more primitive conditions it is essential to provide for effective treatment. There is no special virtue in treating an ophthalmia with boric lotion for six weeks. With sulphapyridine it would probably have recovered in three days.

(7) The clinic building and equipment must be as simple and as unassuming as possible. Elaborations are not merely a waste of money, they do actual harm in frightening away a timid population. A great deal can be done by merely demonstrating care and cleanliness in a building which is similar to the homes of the people themselves.

(8) Teaching to begin with must be on the very simplest lines. Such periods as posters, group teaching and any sort of elaborate display can only be employed gradually as the mothers learn to attend to this form of teaching. Much, on the other hand, can be done by habit formation. See that the mother actually wipes the child's nose with a cloth; see that she actually teaches him the 'technique of the toilet'; see that she actually gets him to take the rice congee with a spoon.

(9) To begin with the main objectives must be simplified to the bare minimum. Our advice may be summarized as follows :—

*Antenatals.*—Eat unpolished rice. Get treatment for yaws, worms, malaria and anæmia. Engage a reliable bidan.

*Infants.*—Give breast milk only. No other food for six months. Do not shave the head. The baby must not be adopted by anyone else for at least six months.

*Children.*—Vaccination. Get yaws and worms treated. Give unpolished rice. Teach clean habits. Avoid worms.

*Everyone.*—Fresh air, sunshine, unpolished rice. Use latrines. Grow more foodstuff. Use more soap.

### (c) *Home visiting*

With a very small staff this is necessarily on a restricted scale. It is the side of the work which is most difficult for an untrained staff. It is not possible for an untrained worker to undertake much home visiting, or it brings discouragement and distaste. Still more serious, the visit is perfunctory, the advice is inept and actual hostility may be aroused.

New-born babies and special cases are the first considerations. The bidans (untrained midwives) are instructed to notify the health nurse when a baby is born, or if there is any case of abnormality in pregnancy. Visits are paid as soon as possible after the notification is received, a careful examination is made and advice is given.

Home visiting does not generally include any medicine or treatment. It is felt that if treatment is necessary it is better for the people to make the effort of going to ask for it. Medicine, like anything else what is too easily come by, is not treated with the respect that it deserves. Bottles that are too readily handed out are left untouched or else are casually broken. Some coloured water in a bottle with a gaudy wrapper bought from a pedlar is treated with more reverence than good medicine all because a price has been paid for it.

### (d) *Supervision of bidans (native midwives)*

From our enquiries it was evident that the large infant mortality was due, not so much to the poor obstetrics as to malnutrition and disease in the mother, small and weakly babies and to ignorant child management.

We could do very little and at very great expense by providing government midwives who mostly receive their training in the management of labour under hospital conditions. So it was decided not to try and supersede the old village handy woman or 'bidan', but to try and teach her some very simple rules of conduct. Also we made no attempt to interfere with the 'adat Meleyu', on local customs except in as far as they were definitely harmful to mother or child.

Cases of difficult labour were always advised to come into hospital. The bidans are asked to use all their influence to have the cases brought in time. It is no more advisable to send a doctor into kampongs to conduct cases of difficult labour than to send a surgeon to conduct amputations and laparotomies in a native hut.

The full instructions to bidans may be found elsewhere. The main points are these :—

(1) To bring antenatal cases to be seen by the health nurse.

(2) To insist on the antenatals eating unpolished rice and to get treatment for worms and yaws and anæmia.

(3) To wash their hands with soap and a nail brush (made of coco-nut husk) and to keep their nails short.

(4) To keep a basket with bottles, basins, towels, etc., total outlay about two dollars. To bring it regularly to be inspected by the health nurse who will keep it supplied with cord ligatures, eye lotion, swabs, etc.

(5) To use scissors for cutting the cord and an antiseptic dressing, instead of bamboo or a bit of old glass followed by sireh and spit.

(6) To realize the importance of breast feeding.

(7) To report all births and all abnormalities and anxieties to the health nurse.

(8) To bring all complications of labour to be treated in the hospital. The delay that is caused by sending to fetch the nurse or doctor is always much greater than would be the case if the woman is taken straight into the hospital.

### (e) *Hygiene in schools*

One of the most depressing things about our civilization in the past is that education for a thousand years has been dominated by the monastic and the celibate minded. This has resulted in more attention being paid to academic subjects than to those that are of practical value in life. The consequence is that one sees that children of the educated classes may be even more unhealthy than those of the uneducated. Too often one finds the teacher's children just as unhealthy as any in the village, artificially fed, overclothed, eating sophisticated food, infected with worms, and, in addition, fed on a variety of patent medicines. This is true of many countries in the world. Now in Britain there is loud demand for more training in mothercraft for girls, more insistence that the child should be taught in school how to regulate his life and his adjustments to his own personal problems, his family, industry, community and state.

The efficiency of the teaching and practice of hygiene in schools varies considerably. On the whole, and with some very marked exceptions, it would seem that hygiene is indifferently taught and the methods used are not sufficiently practical.

There are four methods of learning :—

(a) by receiving information,

(b) by experiment,

(c) by observation, and

(d) by formation of habit.

All these should be made use of in teaching hygiene. As at present only the first is used in many schools and there seem to be few teachers who impart knowledge of hygiene with

that pure passion that they can pour into geography and literature.

The teaching is based on the four methods mentioned. Lessons are given on essential subjects—unpolished rice and how to cook it, worms and how to avoid them and so forth. They actually do the cooking and eat the rice. They actually look at the worms and they actually form the habit of washing their hands before food. There is a row of bamboo pitchers in the manner of the Health School in Java, and they are in daily use. They learn to make their own tooth and hand brushes from coco-nut husks and stems. There are also lessons and demonstrations in the care and feeding of babies.

School medical inspections take place yearly and efforts are made to get medical treatment for those who need it. It is hoped in future to link up these inspections with more health work, both curative and preventive. It is hoped also that the dental work among school children may be extended.

Ultimately school health work should link up with lectures on economics and the best way of spending money, and with agricultural work and with all the factors that go for rural and for urban improvement. There is no reason why fathercraft and citizenship should be counted of less importance than mothercraft.

Probably some of the most valuable lessons will be learned in the schools where welfare centres are actually being held once a week. In these and in the lectures given by the health staff the teaching is made as simple and as practical as possible.

#### (f) *Education of the medical staff and others*

An important part of the programme was to permeate the medical department with more ideas of preventive medicine.

The doctors as a whole in this country have shown little interest in pædiatrics, either curative or preventive. In the final examination at the College of Medicine, Singapore, there may or may not be one question set on some pædiatric subject. There is never more than one, and there is no practical examination. It also appears that people in this country have not developed any abounding faith in the ability of Western practitioners to look after their children. When one remembers that infancy and childhood are periods of great mortality and morbidity, it is curious to consider how little attention has been paid to these age periods.

Lectures were given to dressers and nurses on the subjects that seemed to be most essential to the health of Trengganu and most neglected by orthodox medicine. As these subjects are often inadequately described in the usual textbooks, the notes were cyclostyled and circulated. Lectures on welfare work and on the care of children were given by the health nurse. Throughout the teaching and demonstrations and in the actual management of the hospital and medical department, every effort has been made

to emphasize the importance of good food, cleanliness and fresh air and on all the factors that are important in the prevention of disease.

The nurses and some of the dressers took it in turn to work with the health nurse in the welfare centres and at the visiting. In this way the staff became interested in the objects and in the methods of welfare work, and the welfare centres became associated with the hospital. The result of this is that people coming into hospital are often given some instruction in the prevention of disease.

Improved methods in the care of children has been popularized not only in the hospital and clinics but also in the homes of the staff, with the most gratifying results.

The people of Trengganu have a misguided idea of the use of medicines.

Efforts have been made to get the population to realize the importance of healthy habits and food rather than to put their trust in bottles of medicine, but little progress has yet been made in this respect.

It was hoped that first-aid classes might lead to increased interest in health, and after a couple of false starts they were finally given to members of the police force and to senior boys at the English school.

Among those most in need of health education are the educated. The current 'popular biology' and 'popular medicine' result in numbers of Europeans and others believing that there is danger in child welfare as it may interfere with the jungle law of the survival of the fittest. These archaic conceptions have to be remedied, while the 'educated' among the local people have to be reclaimed from the heresies of artificial feeding, overclothing and sophisticated food which generally seem to go with literacy.

#### (g) *Costing*

The total amount spent on the health survey was \$4,500 in 1940 and \$10,000 up to June 15, 1941.

The welfare work has been under the supervision of Dr. Scharff, the medical officer, and the health staff, but the only specific outlay on welfare work has been as follows:—

Senior health nurse \$260 per month salary and allowances.

Two bidans in training at \$12.50 each per month salary.

Minor expenses at \$20 per month.

Otherwise the work has been done by the already existing medical staff, sanitary inspectors, dressers, etc. Treatment costs at the centres were met from the medical vote, but there was no increase in the quantities of drugs used, but merely a redistribution.

The total amount that has been spent on buildings up to the present is \$156.

It has been our object to spend every available cent on personnel and as little as possible on buildings and non-essentials.



*(h) Results*

It is now ten months since the survey was first started.

It is impossible to give any accurate or statistical appraisal of the results at the present stage.

We are trying to introduce a system of education, not to perform a conjuring trick, so that instantaneous results are not to be expected.

Numbers of attendances are in themselves some indication of the popularity of the centres. The numbers of vaccinations and injections for yaws are a contribution towards the health of the state. It must be remembered that about 70 per cent of these attendances are Malays, and that Trengganu is supposed to possess the most backward and timid Malay population in the peninsula. And our only bribes are medical treatment and good advice. The attendance at the welfare centres in August 1941 totalled over 4,000.

The teaching in the schools has made a start. The health nurses' lessons in hygiene and mothercraft at the girls' school seem to be appreciated and both the dressers and the pupils seem to be interested in the teaching in the boys' schools. The syllabus is made as practical as possible—details of it may be found elsewhere. Travelling dressers are encouraged to centre more and more of their work on the schools.

There has been some increase in the number of Malay women and children coming to hospital, both for treatment and for admission.

The supervision of bidans is a slow method of improving the midwifery, but it is the best that we can manage under the circumstances. Even if a large staff of highly trained midwives were suddenly imported, they would not as yet be patronized by the people.

As far as the education of the medical staff and others is concerned, I think there are definite signs that interest has been aroused, and there is no reason why this should not increase very considerably. At any rate there has on all sides been the most kind co-operation, and often enthusiasm.

It has not been possible yet to do much in the way of 'pushing the work into the kampongs' because we want to make quite certain of what we are pushing. We want all the workers to learn the lessons of prevention not only in theory, but to know them in practice. We want them to know the results so well that they will speak and act with conviction. When the foundations are sure, then the whole structure will rise easily and certainly.

The most important result is that it has been definitely proved that Malays will attend welfare centres, they will listen to advice, they will follow rational methods of bringing up their children, they will come for medical treatment and injections if and when they are convinced that the exponents of these things know their jobs, and secondly, if and when they themselves

are sufficiently healthy to react normally to a normal stimulus.

September 1941

*Postscript—January 1942*

Since this was written, many things have happened which affect the work and Trengganu.

My term of service in the state ended in October. But the work had reached a stage when it was on the point of 'spreading out into the kampongs', and the health nurse was due for her holiday. It seemed better not to leave at that juncture, when another three months might put the whole scheme on a better footing, might do much to establish the methods of working the centres, and the methods of expanding into new areas. For example there was Besut.

Then came December 8, 1941.

Besut was the first part of Trengganu to be bombed by the Japanese; on December 10 we were ordered to evacuate. The medical officer, Dr. A. L. Shield, refused to leave, but two days later he was also forced to go.

To have to abandon the work, the workers and the patients, particularly when everything was developing so superbly, was a sort of nightmare. Everyone of us leaving Trengganu had the same feeling of overwhelming deprivation. We shall live in the hope of returning.

Political cataclysms will pass away, but the world will still seek better ways of guarding its children. This monograph is offered in the hope that the pattern on which the work was built will again be of service to the children of Trengganu, and perhaps to others.

## Current Topics

### Some Factors Affecting the Incidence of Post-Anæsthetic Vomiting

By R. M. DAVIES, M.R.C.S., D.A.

(Abstracted from the *British Medical Journal*, Vol. II, 25th October, 1941, p. 578)

THE author has presented in this article some facts about post-anæsthetic vomiting which are well recognized and others which have not in the past received due attention.

The findings are based on a consecutive and unselected series of 1,000 cases, which had been submitted to anæsthetics and surgical procedures of every type, and they are compared with findings obtained in four series of one hundred cases, which had been submitted to the following anæsthetic sequences:—

Nitrous oxide, oxygen and ether.

Pentothal sodium, nitrous oxide, oxygen and ether.

Pentothal sodium, cyclopropane, nitrous oxide, oxygen and ether.

Pentothal sodium, nitrous oxide and oxygen.

Consideration of the findings obtained revealed the following facts:—

(1) The sequence nitrous oxide, oxygen and ether provided the highest incidence of post-anæsthetic vomiting.

(2) This figure was reduced by one-third by the preliminary addition of pentothal sodium.

(3) The addition of cyclopropane to the anaesthetic sequence did not raise the incidence of post-anaesthetic vomiting.

Consideration of sex incidence showed post-anaesthetic vomiting to be more frequent in females than in males, and that preliminary pentothal reduced the incidence by a greater proportion of females than was the case with males.

A study of the relation between operative procedure and anaesthetic revealed the following:—

(1) Oro-nasal operations had no effect on the vomiting rate, although it has often been said that patients always vomit after tonsillectomy.

(2) The procedure of dilatation of the cervix in gynaecological operations caused a rise in the post-anaesthetic vomiting rate, while the type of anaesthesia employed had to have little or no effect upon its incidence in these cases.

A note on the prophylaxis and treatment of the condition is added.

### The Eradication of Refractory Gonococcal Infections by Combined Artificial Fever-Chemotherapy

By W. M. SIMPSON  
D. L. ROSE

and

H. W. KENDELL

(Abstracted from the *British Journal of Venereal Diseases*, Vol. XVII, July-October 1941, p. 185)

THE authors of this paper report that by administration of sulphonamides for a number of hours immediately prior to a single session of artificial pyrexia, they were uniformly successful in eradicating gonococcal infection in a series of cases which had proved resistant to or intolerant of sulphonamide treatment, and that the whole period of hospitalization was reduced to 48 hours. They say 'The implications are apparent in the application of this therapeutic programme for the more prompt and certain eradication of gonococcal infection to persons engaged in vital military, naval and industrial pursuits'.

The value of artificial fever in the treatment of gonorrhoea was established before sulphonamide treatment was introduced. It was used mainly for complications. Improvements in the apparatus for inducing pyrexia and for care of the patient during it have made it possible to increase the length of each sitting and so to reduce the number of sittings; at the same time the treatment has become safer, and therefore applicable to a wider range of cases. The present report relates to 105 patients who had proved either intolerant of or resistant to sulphonamide treatment, and were each treated with a single session of fever with or without supplementary chemotherapy. The variations in the application of this principle of treatment with the number of cases and cures were as follows:—

- (a) Eight hours at 106.6°F. (about 41°C.), 9 cases and 1 cure.
- (b) Ten hours at 106.6°F. (about 41°C.), 11 cases and 7 cures.
- (c) As (b) but with sulphanilamide orally for 18 hours immediately before the fever, 20 cases and 20 cures.
- (d) As (b) but with sulphanilamide administered intravenously once immediately before the fever, 16 cases and 13 cures.
- (e) As (b) but with Promin (the sodium salt of pp'-diamino-diphenylsulphone - NN'-didestrose-sulphonate, a very soluble sulphonamide compound given intramuscularly during the fever, 11 cases and 7 cures.
- (f) As (b) but with Promin given intramuscularly for 18 hours before the fever, 11 cases and 11 cures.

(g) As (f) but temperature 106°F. (about 41°C.), 7 cases and 7 cures.

(h) Eight hours at 106°F. (about 41°C.), with either Promin (4 cases) or sulphathiazole (11 cases) orally for 18 hours before the fever, 15 cases and 15 cures.

Thus, whereas fever alone and fever with sulphonamide therapy in one dose immediately prior to the fever or administered during the fever was not always successful, fever with sulphonamides for a number of hours immediately prior to the fever eradicated the infection in every case. This method of administration enabled the pyrexia to be reduced in degree and duration which had the advantage of reducing the post-pyrexial malaise and enabling the patient to be discharged from hospital within 48 hours of admission. The dosage of Promin given orally for 18 hours was 0.5 g. six times; that of sulphathiazole was 2 g. at once followed by five doses of 1 g. The methods of diagnosis and the tests of cure were irreproachable.

### The Use of Riboflavin in the Treatment of Corneal Diseases

By K. W. COSGROVE, M.D.  
and

PAUL L. DAY, Ph.D.

(Abstracted from the *American Journal of Ophthalmology*, Vol. XXV, May 1942, p. 544)

THE first careful study of the ocular manifestations of a condition that is now recognized as uncomplicated riboflavin deficiency in the rat was reported in 1931 by Day and others. They reported the following incidence of ocular manifestations in the rats observed: alopecia of the eyelids, 68 per cent; lacrimation, 60 per cent; conjunctivitis, 96 per cent; discharge, 92 per cent; thick, swollen, inflamed lids, 92 per cent; cataract, 94 per cent; and anterior interstitial keratitis, 100 per cent.

In 1937 they demonstrated that pure riboflavin, natural or synthetic, would prevent the keratitis, cataract, and other ocular manifestations of 'vitamin-G' deficiency. The following year the same laboratory reported that the parenteral administration of pure riboflavin to rats with ocular manifestations of riboflavin deficiency resulted in the rapid disappearance of the keratitis, and in many cases the arrest of the cataractous changes. Not all investigators have observed such a high incidence of cataract in riboflavin deficiency. Keratitis and vascularization of the cornea were more consistent ocular changes than cataract and were improved by addition of riboflavin to the diet.

Recent reports on human riboflavin deficiency indicate that the ocular manifestations are almost the exact counterpart of the picture that is seen in the eye of the rat with regard to the pathologic alterations in the cornea and related structures. Up to the present time no conclusive evidence has been presented that would show whether any cases of human cataract are the result of riboflavin deficiency.

In 1939 Pock-Steen reported the ocular symptoms of patients suffering from sprue and related disorders. He found that the administration of riboflavin resulted in improvement of the visual acuity in such patients who had a condition which he termed 'twilight blindness'.

Sydenstricker and associates stated in 1940: 'Photophobia, dimness of vision, and actual impairment of visual acuity were promptly, even dramatically, relieved by the administration of riboflavin in some cases before visual changes occurred in the cornea. Congestion of the sclera, vascularization and opacities of the cornea, and abnormal pigmentation of the iris responded rapidly to the administration of riboflavin'. Further effectiveness of riboflavin in the treatment of nutritional keratitis has been presented by Spies and associates and by Sydenstricker. The latter report stated: 'At the present time it seems that superficial vascular keratitis is the earliest and most common

visible manifestation of riboflavin deficiency as well as a rather reliable index of early deficiency of the B group of vitamins.

#### EXPERIMENTAL

Twenty-eight patients with corneal disease have been treated with riboflavin. The results were varied, dependent upon the aetiology. Cases of interstitial keratitis associated with hereditary syphilis responded much more rapidly when riboflavin was administered than when antiluetic treatment alone was given. Two cases of phlyctenular keratoconjunctivitis improved rapidly under this therapy. One patient had previously been treated for two months without improvement. Cases of corneal disease in which no definite

aetiological factor could be determined were presumed to be possible cases of ariboflavinosis. Some of these responded miraculously upon the addition of riboflavin to the diet. Recurrences were noted in one case when the vitamin was omitted from the diet. Allergic cases did not respond; the conjunctival irritation and the steaming of the cornea were not greatly affected by the administration of riboflavin. In one case of linear keratitis of obscure aetiology there was no improvement; in another, in which the keratitis was associated with mature cataracts, the keratitis was improved but no change was observed in the cataract or visual acuity. Riboflavin cannot be considered a specific for all types of keratitis, but it seems to facilitate the healing of some corneal lesions.

## Reviews

1. **CLINICAL ATLAS OF BLOOD DISEASES.**—By A. Piney, M.D., M.R.C.P., and Stanley Wyard, M.D., F.R.C.P. Fifth Edition. 1942. J. and A. Churchill Limited, London. Pp. viii plus 134 with 46 illustrations, 43 in colour. Price, 16s.
2. **SYNOPSIS OF BLOOD DISEASES.**—By A. Piney, M.D., M.R.C.P. 1942. William Heinemann Medical Books, Limited, London. Pp. ix plus 120. Illustrated. Price, 10s. 6d.

DR. PINEY is one of the best known writers on anaemia in Great Britain. He has contributed some books that are very popular amongst students and practitioners. It is true that his books are not always well received by the more advanced haematologists but perhaps it is for this reason that they appeal to the practitioner and student. Whether or not they advance the cause of haematology we are not prepared to say.

His *Clinical Atlas of Blood Diseases* which he has written in conjunction with Dr. Wyard is certainly one of the most popular of his publications, and deservedly so. It contains a very large number of plates which are well reproduced and will certainly help the student to recognize the different forms of red cells he will encounter in the blood in various blood diseases and in the sternal puncture material. Another feature of this book is the very useful glossary which we feel should always be included in any book on a specialized subject, but seldom is. The fifth edition of this book will certainly enhance the reputation of the writers. It has been brought up to date in a number of ways; the addition of the method of calculating haematological constants, and of the percentages of the different cells in normal sternal puncture go some way to refute the criticism reviewers in the past have made about Dr. Piney's books.

Altogether it is a book that we can strongly recommend to the student and practitioner. The price is 16s., high for a small book, but in these days paper is scarce and plates probably very expensive to produce.

In his other book, *Synopsis of Blood Diseases*, we feel that Dr. Piney has overstepped the mark. This book does not seem to us to fill any want. In peace time, the publication of a book is a matter between the publishers and the author, but in war time it is a matter between the publishers, the author, and Lord Woolton, or whoever it is that rations paper. In this particular case, I am very surprised that he allowed the paper to be used for the purposes of this superfluous book. The book contains some accurate information, a certain amount of inaccurate information, and a very great deal of very inadequate information on a number of subjects. Let us take one example:—

On page 104, under 'Leishmania' (sic) the following statements occur:—

'Progressive hypochromic anaemia falling as low as a million corpuscles per c.mm.'

*Comment.* This is quite untrue; the anaemia is usually orthochromic, or sometimes slightly hyperchromic, but seldom hypochromic, unless there is some complicating factor. Further, it is not progressive and seldom drops to the level of one million red cells. On the contrary, the anaemia tends to stop at about three million red cells, even in the more advanced cases.

'The most striking character of the blood picture is leucopenia which may be as low as 500 per c.mm. (Death may occur with all the signs of agranulocytosis.)'

*Comment.* This is perfectly true.

'There is great reduction of neutrophils (but those present are often moderately immature), considerable relative lymphocytosis and well marked increase of monocytes.'

*Comment.* This is also true.

Rarely the organisms can be found inside monocytes in the blood.

*Comment.* This is a most inadequate statement. The meaning is not clear. Does he mean, 'they are sometimes found inside monocytes but usually outside', or does he mean 'they are rarely found in the blood and, if they are, they are found in monocytes'? In neither case is the statement true. The frequency with which they are found depends on the persistence of the searcher. They will be found in 60 per cent of cases of kala-azar if a thorough search is made; not at all if the search is a casual one. They are usually in monocytes, but may be in polymorphonuclears.

The parasites are usually easily found in films made from material obtained by liver puncture, less commonly from the marrow and still less often from the spleen (spleen puncture in this disease is not free from danger).

*Comment.* This is the exact reverse of the truth, that is to say, parasites are usually found in the spleen, with more difficulty in the marrow, and with still more difficulty by liver puncture. Reference to any experienced writer on kala-azar diagnosis will confirm this statement. Spleen puncture undoubtedly is dangerous, but so is crossing the road, if you don't do it in the proper way. The reviewer's score in spleen punctures is approaching five figures, without mishap.

Treatment. See textbooks of tropical diseases. Here it is enough to indicate that antimony is essential, either tartar emetic or one of the less toxic modern preparations, e.g. neostibosan.

*Comment.* It is difficult to see why this paragraph was put in at all if reference is to be made to other textbooks. It is not true that antimony is essential, and tartar emetic is practically never used these days.

L. E. N.

**DEMONSTRATIONS OF PHYSICAL SIGNS IN CLINICAL SURGERY.**—By Hamilton Bailey, F.R.C.S. (Eng.). Eighth Edition. 1942. John Wright and Sons Limited, Bristol. Pp. xii plus 336, with 455 illustrations, a number of which are in colour. Price, 25s.

THE production of the eighth edition of this book, after fourteen years and in the middle of a war, speaks well for its popularity. This edition has been made under considerable difficulties as explained in the preface but, in spite of these, it can be confidently stated that it is as good as ever—in particular the reproductions in colour deserve special mention and one looks forward to the day when all photographs, in this and other medical books, will be in colour.

Throughout the book the various physical signs are lucidly described—in the text and by pictures, of which there is an abundant supply. For the most part simple tests are described, which can be applied by anyone having the minimum of diagnostic armamentarium.

Certain chapters, such as the ones describing the examination of the abdomen and those on the genito-urinary system, deserve special note, being both very clear and concise. The chapter on the breast is also particularly well done and emphasizes the importance of comparison of the normal and the abnormal side—a method of examination which the author strongly advocates.

By way of comparison, the chapters on the examination of the central nervous system (i.e., the head, spine and peripheral nerves) are not up to the high standard maintained elsewhere in the book and might to advantage be more detailed. Such tests as the anvil test for the spine and the numerous signs connected with exophthalmos might well be omitted, as the author almost suggests.

In conclusion, this book can be strongly recommended to all medical students starting as surgical dressers and to those working for final examinations. A periodical perusal by practitioners would probably enhance the value of their clinical examination and remind them that in diagnosis it is the examination of the patient which comes before other tests such as the laboratory and x-rays.

G. C. T.

**PATHOLOGY AND TREATMENT OF WAR WOUNDS.**—By Sir Almoth E. Wright, M.D., F.R.S. 1942. William Heinemann Medical Books Limited, London. Pp. viii plus 208. Illustrated. Price, 21s.

CONTAINED in the 205 pages of this book is much of the work which has formed the basis of the treatment of wounds during this war and, for this reason if for no other, it should be read by all those who are scientifically interested in to-day's war surgery.

The chapters on wound infections stress the importance of the simple saline dressing—denouncing the use of antiseptics and encouraging the adoption of aseptic principles by thorough wound débridement and dependent drainage.

The chapters on gas gangrene are of particular interest. Although antitoxin treatment combined with chemotherapy by sulphapyridine (or sulphanilamide) appear to be distinct modern advances, the treatment recommended by the author was a definite advance on any in vogue at that time and even now the alkalization of the patient might be adopted more often to combat the toxæmia of gas gangrene.

Throughout the book it is delightful to study the simple experimental ways that the author and his co-workers adopted to study their problems as also is the formulating of the simple questions he asked himself and then proceeded to answer—indeed it is an inspiration for present-day research workers.

G. C. T.

**THE FOOT AND ANKLE: THEIR INJURIES, DISEASES, DEFORMITIES, AND DISABILITIES: WITH SPECIAL APPLICATION TO MILITARY PRACTICE.**—By Philip Lewin, M.D., F.A.C.S. Second Edition. 1941. Henry Kimpton, London. Pp. 665, with 304 illustrations. Price, 42s.

In the second edition of this book the author deals in a comprehensive way with the various conditions, both pathological and non-pathological, of the foot and ankle. Besides this, other matter, e.g. gynaecological conditions and lesions definitely confined to the leg, is included and so, with a section on the military aspect and a certain amount of repetition, the book is increased to 620 pages.

One feels that for a work of this standard a mere 15 pages for the description of the embryology and anatomy of the foot and ankle is insufficient and that perhaps it would have been better to have omitted this section—and on the same score some parts of chapter 3.

In the prefaces it is stated that the book is meant for the student, general practitioner, industrial surgeon, younger orthopaedic surgeon and the army medical officer. With guidance for such doctors in view it would seem unnecessary to give detailed description of alternate techniques of operations, e.g. in the treatment of hallux valgus. Surely it would be better adapted to the purpose of the book if the operation which in the opinion of the author is the most suitable were described and at most one other?

More detail might have been given to local anaesthesia and fractures—both being important subjects in these times.

The orthopaedic and operative sides, as also the dermatological, are very well done and repay study. The various steps in the operations are lucidly described and good illustrations are provided throughout. The chapter on anterior poliomyelitis is one of the best in the book—the treatment of the various stages being given in detail.

A full bibliography is given which together with the book itself forms a sound basis for the study of the conditions of the foot and ankle.

G. C. T.

**MEDICAL RESEARCH COUNCIL. SPECIAL REPORT SERIES NO. 243. CHRONIC PULMONARY DISEASE IN SOUTH WALES COAL-MINERS. I—MEDICAL STUDIES. A—REPORT BY THE COMMITTEE ON INDUSTRIAL PULMONARY DISEASE. B—MEDICAL SURVEY.**—By P. D'Arcy Hart and E. A. Aslett, with contributions by D. Hicks and R. Yates. C—PATHOLOGICAL REPORT.—By T. H. Belt with assistance from A. A. Ferris. 1942. Published by His Majesty's Stationery Office, London. Pp. xiv plus 222. Illustrated. Price, 10s. 6d.

SINCE 1929, when compensation for silicosis first became payable to men in the coal mining industry, the number of disablement cases has increased rapidly, and there has been greater mortality from respiratory disease among coal miners in South Wales than elsewhere in Great Britain.

In 1936 the Medical Research Council were asked by the Home Office and the Mines department to investigate the problem. A committee was formed, and investigations began in 1937. It involved mainly clinical and radiological examination of about 2,000 miners and 500 coal trimmers.

A convenient classification of pulmonary changes caused by dust in coal mines has been devised. There are two main divisions: (a) consolidation and (b) reticulation. The former includes discrete nodulation and various forms of conglomerate shadow, and corresponds to the changes which generally go under the name of silicosis in coal miners.

The latter is an important form of roentgenographic abnormality that has been detected among the South Wales coal miners. This may be associated with respiratory disability, but usually does not conform to the criteria indicating silicosis for compensation

purposes. As a result of histological study it has been termed 'dust-reticulation'. It is characterized by retention of silica as well as carbon, and increase of reticular tissue in the lung, silica being present mostly in the form of silicates and the reaction being proportional to the amount of dust. Thus this condition differs from classical silicosis.

The data collected suggest that none of the methods and processes used in mining coal is the main causative factor, although reduction of exposure of the collier to dust produced in rippling, relegation of short-firing at particular times, and chilling of spakes would be desirable.

**HANDBOOK OF APPLIED PHYSIOLOGY OF THE NERVOUS SYSTEM, THE SPECIAL SENSES, MUSCLE AND NERVE.**—By Harendra Nath Das, Rai Bahadur, M.A., M.D. Das Gupta and Co., Calcutta. 1942. Pp. 443. Price, Rs. 6

In this work, written by an Indian for Indian students, Dr. Das has set himself a monumental task. How well he has carried it out, the reader must judge for himself.

The whole ground is well covered and the arrangement of the subject-matter is excellent. There is hardly a detail which is not adequately dealt with.

The book is interspersed with clinical notes and references to Applied Physiology which should help to supply the connecting link between Physiology and Medicine.

There are numerous excellent illustrations accurately reproduced which should prove of great help to the student.

The author is to be congratulated not only on the energy displayed in collecting and arranging such a mass of information in a form particularly acceptable to the Indian student. The use or misuse of the definite article, which is so characteristic of the writings of Indian scholars, may be neglected as it does not detract from the scientific value of the work.

J. A. S.

**MEDICAL RESEARCH COUNCIL. SPECIAL REPORT SERIES NO. 245. REPORT OF THE COMMITTEE ON BED-BUG INFESTATION, 1935 TO 1940.**—Published in July 1942 by His Majesty's Stationery Office, London. Pp. 64. Illustrated. Price, 1s.

No disease has yet been laid at the door of the bed-bug, yet it is undoubtedly an objectionable parasite. At the least, it is liable to disturb sleep.

The report of this committee gives valuable information regarding the bionomics and control of the parasite.

**ANTENATAL AND POSTNATAL CARE.**—By Francis J. Browne, M.D. (Aberd.), D.Sc., F.R.C.S. (Edin.), F.R.C.O.G. Fourth Edition. 1942. J. and A. Churchill, Limited, London. Pp. viii plus 592, with 84 illustrations. Price, 24s.

THE 4th edition of Mr. Browne's book offers in little bulk one of the best textbooks on prenatal and postnatal care offered in the past five years not only because the material is sound, well presented and succinct, but also because the book has been planned in the modern manner. All essentials have been shed, each chapter carries its own bibliography, important advances in pathological research and in harmonology have been included.

Much new material has been added in this edition but so carefully has the selection been made, especially in regard to the influence of hormones upon female physiology, upon pregnancy and upon abnormalities, that one may say that although five years hence it may be possible to add much to this chapter it is unlikely that anything will be contradicted or withdrawn.

The chapter on the history and development of antenatal care and that on the 'Uses and Value of Radiology in Obstetrics', by Salmond, are valuable additions to the text. The diets of the pregnant and the nursing woman have received due attention.

In appendix 'A' are given type-forms for record of prenatal and obstetric cases.

In short, this is a book which every medical student and obstetrician will find useful.

L. G.

**ANNUAL REVIEW OF BIOCHEMICAL AND ALLIED RESEARCH IN INDIA, VOL. XII FOR 1941.**—By the Society of Biological Chemists, Malleswaram P. O., Bangalore. Pp. 84. Price, 6s. or Rs. 3

THIS review is divided into the following sections: (1) enzymes, (2) general nutrition, (3) vitamins, (4) protein, carbohydrate, fat and mineral metabolism, (5) pharmacology, (6) animal nutrition, (7) chemistry of plant products, (8) plant physiology, (9) soils and fertilizers, and (10) technical mycology. Each section has been compiled by one or two authors who have experience of the subject and a study of the book gives a fair idea of the type of research carried on in the different laboratories in India. The book is pleasant to read and should be welcomed not only by biochemists and chemists but also by others who are interested in the growth of science in India.

S. G.

## Abstracts from Reports

**ANNUAL REPORT OF THE UNION MISSION TUBERCULOSIS SANATORIUM, AROGYA-VARAM, NEAR MADANAPALLE, SOUTH INDIA, FOR 1940-41**

DURING the year 471 patients were admitted and 465 patients discharged, leaving on 30th September, 1941, 259 patients. The total number of patients treated during the year has been 724. The daily average number of patients treated has been 255.76 for the whole year.

The number of beds available during the year varied from 249 to 253, but at times extra beds have been fitted in temporarily.

Of the 465 patients discharged, 335 were men and 130 women. Hindus numbered 229 or 49.3 per cent, Christians 182 or 39.1 per cent and Muslims 38 or 8.2 per cent; in addition, there were 11 Buddhists, 4 Chinese and 1 Jew.

Of the 465 patients, 400 were found to be suffering from pulmonary tuberculosis. Of the remainder, 8 were found to be suffering from other tuberculous conditions, namely 3 from glandular tuberculosis, 3 from intestinal tuberculosis, 1 from tuberculosis of the hip, and 1 from tuberculosis of the spine; 18 patients were found to be suffering from non-tuberculous lung diseases, namely, 4 from bronchiectasis, 6 from lung abscess, 3 from actinomycosis of the lung, 5 from lung disease associated with eosinophilia; 23 patients were found to have no active tuberculosis; 13 patients were proved to be non-tuberculous and not suffering from any serious disease; 1 patient was found to be suffering from chronic malaria and 2 from heart disease.

Of the 400 patients suffering from pulmonary tuberculosis, 337 are included in the medical statistics.

Twenty-five, or 7.4 per cent, were in first stage or early cases, 42 or 12.5 per cent in second stage or medium severe cases, and 270 or 80.1 per cent in third stage or advanced cases.

Of the 337 patients, 253 or 75.1 per cent were discharged with positive results, viz, 28 as 'arrested', 168 as 'much improved' and 57 as 'improved'. Among the patients discharged with negative results, 40 were discharged as stationary, 16 as worse and 28 died.

The training of doctors for the Tuberculous Diseases Diploma of the Government of Madras has continued during the whole year.

The senior class of the Vellore medical students came as usual for a course of two weeks in the diagnosis and treatment of tuberculosis.

Owing to the large increase of operative work, an extension of the post-operation rooms in the operation block became an urgent necessity. A wing of six new rooms has been added. Four additional special wards have been built.

In August the sanatorium had the honour of a second visit of Her Excellency the Marchioness of Linlithgow. Her Excellency opened the Lazarus Memorial Building in the ex-patients' colony.

#### ANNUAL REPORT OF THE COMMITTEE OF THE INDIAN CHEMICAL MANUFACTURERS' ASSOCIATION, CALCUTTA, FOR THE YEAR 1940-41

THE third annual session of the Indian Chemical Manufacturers' Association was held at Bombay on the 19th and 20th September, 1941. Delegates from different parts of the country participated in the session.

Raj Mitra B. D. Amin in his presidential address emphasized that industries in this country faced immense difficulties after the outbreak of war, due to dislocation in supplies of essential and basic materials, but things got themselves adjusted to a certain extent later on. Sodium dichromate, potassium dichromate, liquid chlorine, zinc chloride, soda ash, tannic acid, carbolic acid, oxalic acid, acetic acid, etc., for which the country was completely dependent on foreign supplies, are being produced to a considerable extent in this country. Projects for the production of caustic soda, bleaching powder, sodium bicarbonate and for further production of soda ash, zinc chloride, several sulphates, acetic acid, etc., are under way. Besides, India is now almost self-sufficient in respect of sulphuric, hydrochloric and nitric acids, naphthalene, copper sulphate, alum, aluminium sulphate, magnesium sulphate, glycerine, etc.

In the manufacture of drugs, pharmaceuticals and proprietary medicines also, the progress has been to a certain extent satisfactory.

Most of the provincial and State governments have expressed readiness to make available to the manufacturers the facility of clinical trial in hospitals under their control. It is now for the manufacturers to take advantage of the facility and make Indian products more popular. The time has come when the industrialist and the scientist should realize the utmost importance of closer co-operation.

*Interview with Lieut.-General Sir Gordon Jolly.*—The committee arranged a meeting of the local members of the Association with Lieut.-General Sir Gordon Jolly, Director-General, Indian Medical Service. Mr. J. N. Lahiri was in the chair. Besides members of the Association, the meeting was attended by Major-General J. Taylor, Director, Central Research Institute, Kasauli, Colonel W. C. Paton, Surgeon-General to the Government of Bengal, Brevet-Colonel Sir R. N. Chopra, Dr. J. N. Ray and Major S. P. Bhatia. The following subjects were discussed at the meeting:—

(1) Purchase of medical supplies from England over a long forward period, (2) manufacturing and importing activities of the Government Medical Stores Depots, (3) purchase of vaccines and sera by the Government from Indian manufacturers, (4) difficulties experienced in exports of drugs and medicines out of India and (5) necessity of giving permission to private manufacturers to undertake the manufacture of opium alkaloids. General Jolly explained the position and the Government's policy in purchasing drugs and medicines and stated that he would try to maintain closer touch with the manufacturers.

#### ANNUAL REPORT OF THE CHEMICAL EXAMINER'S DEPARTMENT, GOVERNMENT OF MADRAS, FOR THE YEAR 1941

THE number of articles examined fell from 9,474 in the previous year, to 8,630 in the year under review.

Cases of human poisoning examined increased from 427 to 432; but the percentage of cases in which poison was detected fell from 55 to 53.2. The vast majority of the poisons detected were organic poisons. The commonest poisons detected were opium or its alkaloids in 43 cases, oleander in 26 cases, copper or its salts in 20 cases, alcohol in 20 cases, datura or mydriatic alkaloid in 15 cases, and cyanide in 12 cases. A few cases of interest are reported.

Animal poisoning cases examined numbered 33, as against 23 in the previous year. Poison was detected in 13 cases. The number of stain cases examined decreased from 1,081 to 1,004. Miscellaneous medico-legal cases involving the examination of fire-arms, bombs, explosives, bones, etc., decreased from 142 to 115.

#### ANNUAL REPORT OF THE BRITISH EMPIRE LEPROSY RELIEF ASSOCIATION, MADRAS PROVINCIAL COUNCIL, FOR 1941-42

IN spite of the difficulties due to war the work of the Association has proceeded with comparatively little interruption. One of the important activities was investigation of childhood leprosy. The total number of cases on the register is now 617. It is being realized that possibly 50 per cent of the cases becomes abortive and is innocuous, and much information has been gathered to estimate whether a leprosy lesion in a child is serious or not. Survey work was carried out by the rural and urban centres. The total urban population so far examined is 16,304 with a gross incidence of 26.4 per thousand, a child rate of 26.6 per cent and open case rate of 14.0 per cent. This indicates a less serious condition than in the rural areas so far investigated, but greater difficulty is experienced in segregating the open cases. Research work on various aspects of leprosy have continued. The 470 leprosy clinics in the presidency have functioned throughout the year with varying success.

## Correspondence

### TREATMENT OF MALARIA IN THE PRESENT EMERGENCY

SIR,—Now with the restriction on the use of quinine coming into force, doctors, especially in tea estates practices, where a large percentage of their cases are malaria, have been hard put to in not being able to get enough of this most important weapon in their armamentarium to fight this dreadful disease. It is high time that some one in authority should lay down a definite line of treatment for treating cases of malaria with this short ration of quinine. An immediate and authoritative direction is all the more necessary because of the spate of recent unseemly controversial letters as regards use and misuse of quinine which appeared in the lay press. These are being used as weapons to snub doctors by dubbing them 'fools who have no common policy for treating even such common cases of every-day occurrence as malaria'. One also feels the unexpressed opinion from the members of the public that when the doctors do not agree amongst themselves about the treatment of simple malaria cases they should not be trusted to treat more difficult cases and should be kept at arm's length!

One cannot blame the public for forming such an opinion about doctors after going through the letters appearing in the daily papers under the signatures of eminent doctors.

One asks in dismay if these letters should have appeared in the lay press at all. Was this display of



knowledge or lack of it, by the eminent signatories, before the public within the bounds of medical ethics?

However, we doctors in the malarious districts look up to you for laying down a definite direction as to the best method of treating malaria (both acute and chronic) with the minimum expenditure of quinine and which will cure our patients with minimum number of invalid days.

B. CHATTERJEE,  
*Medical Officer.*

THE CHARGOLA VALLEY MEDICAL  
ASSOCIATION,  
DULLABCHERRA P. O. AND T. O.,  
SYLHET,  
18th September, 1942.

*Note.*—In our opinion the action of certain doctors in writing to the lay press on technical matters, such as the treatment of malaria is most unseemly, and calls for strong protest.—Editor, *I. M. G.*

## Service Notes

### APPOINTMENTS AND TRANSFERS

COLONEL J. B. HANCE, C.I.E., O.B.E., V.H.S., Inspector-General of Civil Hospitals and Director of Public Health, Central Provinces and Berar, was appointed Officer on Special Duty in the Office of the Director-General, Indian Medical Service, with effect from the 27th July, 1942.

Lieutenant-Colonel C. M. Ganapathy, M.C., C.I.E., I.M.S. (Retd.), is appointed to officiate as Port Health Officer, Bombay, with effect from the afternoon of the 11th August, 1942, *vice* Major M. Sendak.

On return from leave, Lieutenant-Colonel E. Cotter resumed charge of the post of Public Health Commissioner with the Government of India, with effect from the 27th August, 1942.

The services of Lieutenant-Colonel F. R. W. K. Allen, Civil Surgeon, Raipur, have been placed at the disposal of the Government of India Defence Department for temporary military duty from 12th September, 1942.

On return from leave, Lieutenant-Colonel N. M. P. Dotivala, M.C., resumed charge of the post of Deputy Assistant Director-General (Medical Stores), Medical Store Depot, Lahore Cantonment, with effect from the 12th September, 1942.

Major (Acting Lieutenant-Colonel) A. N. Chopra is appointed Assistant Director-General, Indian Medical Service (Recruitment), with effect from the 27th May, 1942.

Major G. B. W. Fisher, officiating Surgeon-Superintendent, Presidency General Hospital, Calcutta, is appointed to be Civil Surgeon, Dacca.

On return from one month's leave Major D. Kelly has been re-posted as Civil Surgeon and Superintendent, Robertson Medical School, Nagpur.

Major W. Scott, Civil Surgeon and Superintendent, Robertson Medical School, Nagpur, has been re-posted as Civil Surgeon, Amraoti.

Major W. T. Taylor, Additional Officer, Medical Store Depot, Bombay, is appointed as Deputy Assistant Director-General (Medical Stores), Medical Store Depot, Calcutta, with effect from the 22nd August, 1942 (afternoon).

Major H. B. Wright is appointed as Additional Officer at the Medical Store Depot, Bombay, with effect from 18th August, 1942, *vice* Major W. T. Taylor, transferred to Medical Store Depot, Calcutta.

On his transfer to the Army Department, Major G. J. Joyce made over charge of the office of Civil Surgeon, Amritsar, on the forenoon of the 17th September, 1942.

Major C. A. Bozman, Deputy Assistant Director-General, Indian Medical Service, was appointed to officiate as Public Health Commissioner with the

Government of India, with effect from the 27th July, 1942 (forenoon), *vice* Lieutenant-Colonel E. Cotter, granted leave.

With effect from the same date, Major C. A. Bozman, officiating Public Health Commissioner with the Government of India, reverted to his post of Deputy Assistant Director-General, Indian Medical Service (Recruitment).

Major C. A. Bozman was appointed Deputy Assistant Director-General, Indian Medical Service (Recruitment), with effect from the 27th May, 1942.

The services of Major R. D. MacRae, an Agency Surgeon, are temporarily replaced at the disposal of His Excellency the Commander-in-Chief, with effect from the forenoon of the 21st August, 1942.

Captain E. Lloyd Jones is appointed Deputy Assistant Director-General, Indian Medical Service (A.R.P.), with effect from the 13th July, 1942.

### (Emergency Commissions) To be Lieutenants

Isabel Daisy Patterson. Dated 29th May, 1942.

David Alexander Kitchen Carnegie. Dated 6th June, 1942.

Theodore Edward Walter Rumboil Wood. Dated 8th April, 1942.

Brenda Fife. Dated 12th April, 1942.

James Shanks Laurie. Dated 4th May, 1942.

Donald Gordon Coutts. Dated 4th May, 1942.

Hilda Margaret Garlick. Dated 7th May, 1942.

Mary Scott. Dated 7th May, 1942.

Mariorice Lawton. Dated 7th May, 1942.

Evelyn Monica Eldrid. Dated 7th May, 1942.

James Thomas Prehdiville. Dated 11th May, 1942.

### INDIAN LAND FORCES

#### (Emergency Commissions)

##### To be Captain (on probation)

Mohindra Singh Babbar. Dated 5th May, 1942.

##### To be Lieutenants (on probation)

Samarendra Chandra Chatterji. Dated 4th May, 1942.

Bernard Albert Hoogewerf. Dated 5th May, 1942.

Dattatraya Sadashio Pathre. Dated 15th June, 1942.

Hem Raj Anand. Dated 25th February, 1942.

#### 3rd July, 1942

Parammal Punakkan Balakrishnan.

Mohd. Abdul Ghani Bhutty.

Sudhirkumar Chakrabarti.

Kalachand Saha.

Zahid Hussain Syed.

Asoke Kumar Bose.

Kehar Singh Radhawa.

Ranbir Singh.

Binoy Sekhar Dutt.

Ruston Mervanji Dastur.

Parimi Venkateswara Rao.

Ramakrishna Bapuji More.

Mani Lal Datta.

Jagdish Chandra Sharma.

Altai Husain.

Jayawant Narayan Karande.

Salai Govindarajan.

Ahmad Sayeed.

Sudhir Kumar Dutta.

Lakshmi Kanta Chakrabutty.

Saurendra Nath Sinha.

Ruzbeh Aderji Mehta.

Gev Sorabji Godiwalla.

Byomkes Guha.

#### 4th July, 1942

George Broughton Smart.

Nripendra Kumar Basu.

Syed Mohammad Khalil Wasti.

Kurichety Somavva. Dated 5th July, 1942.

Toleti Kanaka Raju. Dated 9th July, 1942.

Jhamandas Nichani. Dated 13th July, 1942.

E. G. Michelson. Dated 8th December, 1941.

N. G. De Sarkar. Dated 10th July, 1942.

#### 8th August, 1942

Babu Ram Mahajan. J. Ayaram.

E. R. James. Dated 10th August, 1942.  
Adelia Alice Mary Coutts. Dated 12th April, 1942.  
The undermentioned Officer of the Indian Medical Service (Emergency Commissioned) is seconded for service in the Royal Indian Navy :—  
Lieutenant E. A. Beetles. Dated 15th August, 1942.

(DENTAL BRANCH)  
(Emergency Commissions)  
To be Lieutenants (on probation)

5th June, 1942

Rustom Merwanji Narelvale.  
Edwin D'Souza.  
Edmund Eligius Doodu Morris.  
Natha Singh Sand, L.S.M.F.  
Rama Prasad Lahiri.

10th July, 1942

Krishnu Lal Saini.  
Sadashiv Dattatraya Gokhale.  
Prakash Chander Chona.  
Bhanushanker Kalidas Dvivedi.

11th July, 1942

Dukka Venkata Jagan Mohan Rao.  
Jayant Patel.

13th July, 1942

Nirendra Nath Bose. Om Perakash Bhatia.  
Eugene Nathaniel Pearlman.

(Relative rank)  
To be Lieutenants (on probation)

(Mrs.) Coralie Leonora Mary Drummond. Dated 1st June, 1942.

(Miss) Lorna James. Dated 10th August, 1942.  
(Miss) Helen May Herbert. Dated 6th April, 1942.  
(Miss) Myra Kathleen Beattie. Dated 1st July, 1942.

(Mrs.) Georgina Elizabeth Brindley. Dated 12th July, 1942.

(Miss) Ena Mitra. Dated 29th August, 1942.

INDIAN LAND FORCES  
(Emergency Commissions)  
To be Lieutenants (on probation)

Labhaya Milhotra Ram. Dated 21st February, 1942.  
Karumathil Puthiavil Gopal Menon. Dated 10th July, 1942.

7th August, 1942

Kalmadi Srinivas Rau.  
Mrityunjoy Sen.  
Dulal Chand Basak.  
Maroli Sanjiva Rao.  
Bhabendra Kumar Sen.  
Surendra Chandra Nath.  
Prabhat Prasanna Ghosh.  
Gongesh Kumar Roy.  
Praphulla Chandra Mallik.  
Achanananda Sen Gupta.  
Amarendra Nath Basu.  
Harnarayan Dubey.  
Sasankasekhar Mukherjee.  
Baleshwar Prasad.  
Deba Prasad Chakrabartty.  
Birendra Nath Maji.  
Panchkari Banerje.  
Chiruvolu Suryanarayana.  
Jacob Meyer Lewis.  
Joachim Mathias Pinto.  
Santi Charan Paul.  
Anthony Theodore DeSouza.  
John Reginald Pereira.  
Santosh Kumar Sen.  
Chitoor Tarakesvarlu Hemachandran.  
Devaprasad Sen.  
Kali Das Ganguly.  
Panikulam Francis Verghese.  
Shyam Singh Bisht.  
Mylavarapu Satyanarayana.  
Sudhansusekhar Das.  
Panampully Narayanan Kutty Menon.  
Shre Krishna Narayana Sinha.

Nirendra Nath Ghosh.  
Bhasker Baburao Vaidya. Dated 8th August, 1942.  
Girdhar Guppur Prabhu. Dated 11th August, 1942.

12th August, 1942

Albert Bernard Rustom.  
Mohamed Amin.  
Pritam Singh Sehra. Dated 14th August, 1942.

15th August, 1942

Esmond Arnold Beetles.  
Abdul Hamid.  
Zaffar Mohammad Pandher.

(Within Indian limits)

7th August, 1942

Nau Nihal Singh.  
Amalendu Sengupta.  
Shanker Ram Row.

8th August, 1942

Nagala Govinda Rajulu.  
Sanku Parthasarathy.  
Sripada Venkata Krishnayya. Dated 9th August, 1942.

Burjor Dhunjishaw Mistry. Dated 15th August, 1942.

The undermentioned Captains (on probation) are confirmed in their rank, with effect from the dates specified.

R. S. Verma. Dated 15th March, 1941.

5th August, 1941

A. A. Porinchu. K. N. Joshic.  
M. K. Swaminadhan. J. N. Choksy.  
S. C. Ray. Dated 6th August, 1941.

5th September, 1941

V. A. Belsare. W. M. D'Souza.  
C. M. Kikani. R. Rajagopalan.  
R. C. Bose. Dated 6th September, 1941.

5th October, 1941

S. C. Ghosh. R. M. Nair.  
N. K. G. Kartha. A. Krishnaswami.  
M. L. Sur. A. G. David.  
F. M. Khan. A. Ghaffar.  
R. L. Singh. M. W. William.  
G. J. Rao. M. Arshad.  
U. V. Menon. A. J. Rao.  
P. R. Rao. A. R. Subrahmanyam.  
T. C. Verghese. P. Venkatnarayan.  
K. N. R. Thampi. K. K. Sundaram.  
S. M. Y. Farooqui. V. P. S. Sarma.  
V. B. Patel. R. B. Daruvala.  
B. B. Sahni. R. V. N. Nayudu.  
L. R. R. Lakhkar. N. V. Rao.  
P. H. K. P. S. Nair. B. K. Banerji.  
G. Singh. J. K. Lucas.  
S. Virmani. S. P. K. Pillai.  
M. C. Menon. J. V. Karia.

6th October, 1941

D. S. Singh. T. S. Chohan.  
K. M. Unnikrishnan. H. M. Rao.  
M. Tajuddin.

5th November, 1941

G. Ahmed. V. S. Achrekar.  
H. K. Das. K. N. Ghose.  
D. K. Sen. V. R. Mirajkar.  
M. I. Khwaja. P. K. Varma.  
S. K. Mazumdar. B. S. Patankar.  
P. N. Banerjee. P. I. Alexander.  
S. K. Bhattacharjee. A. S. Norman.  
V. N. Chaturvedi. N. R. Dani.  
V. Swaminathan. P. R. Sastry.  
K. P. M. Pillay. A. K. Ghosh.  
R. K. Saksena. C. B. Kariapa.  
T. D. Chatterjee. N. P. Devadason.  
D. T. Gandhi. G. A. Roche.  
K. N. Bali. Z. H. Khan.  
F. M. James. P. C. Banerjee.

6th November, 1941

C. M. Menon. P. Jagannatham.  
K. M. Kudva. V. A. Rane.  
V. S. S. Ramaswami.

5th December, 1941

|                 |                       |
|-----------------|-----------------------|
| R. S. Garewal.  | S. P. S. Roy.         |
| M. S. Rana.     | M. M. Singh.          |
| M. P. Goel.     | V. K. Kumaran.        |
| F. Khan.        | V. S. Gopalakrishnan. |
| B. S. Baswani.  | N. B. Chaudhury.      |
| V. K. G. Menon. | H. S. Sinha.          |
| M. S. Mallick.  | G. D. Pillai.         |
| M. K. Bose.     | V. K. Prabhu.         |
| A. P. Diwan.    | S. R. Turkhud.        |
| A. P. Devadoss. | K. R. Rajagopal.      |
| M. C. Mathew.   | K. B. Nair.           |
| M. V. Naidu.    | V. Kuruvilla.         |
| V. V. Ainapure. | K. Vullakki.          |
| P. M. Ali.      | A. W. F. Rahman.      |

L. R. Mankodi.

6th December, 1941

|                    |                    |
|--------------------|--------------------|
| P. C. Ghosh.       | K. S. I. Sankaran. |
| S. G. A. Raju.     | P. Vadivale.       |
| N. P. Kundu.       | G. G. S. Rao.      |
| P. B. Chakerberty. | J. B. Singh.       |

R. N. Mitra.

M. R. S. Rao. Dated 7th December, 1941.  
G. P. Srivastava. Dated 10th December, 1941.

5th January, 1942

|                     |                  |
|---------------------|------------------|
| A. C. Sastry.       | V. K. Menon.     |
| J. Eapen.           | S. M. Rao.       |
| G. S. Ramulu.       | N. S. D. Rao.    |
| S. N. Chak.         | B. N. Bali.      |
| U. P. Mukherjee.    | R. S. Kesavaraj. |
| R. K. Mendireth.    | D. N. Maniktala. |
| A. Bashir.          | V. R. Sanzgiri.  |
| K. K. Thampuran.    | B. Devadas.      |
| N. S. S. Narayanan. | D. S. Goel.      |

6th January, 1942

|                      |                           |
|----------------------|---------------------------|
| M. M. Chakraverti.   | V. H. Haran.              |
| B. Sundararamamurti. | K. V. Ganapathi.          |
| O. David.            | F. Freitas.               |
| H. C. Bhattacharya.  | Dated 8th January, 1942.  |
| R. C. Swaminarayan.  | Dated 12th January, 1942. |
| A. H. Vatsyayana.    | Dated 14th January, 1942. |
| T. N. S. Kurup.      | Dated 20th January, 1942. |

The undermentioned Lieutenants (on probation) are confirmed in their rank, with effect from the dates specified :—

H. Singh. Dated 29th August, 1941.

5th October, 1941

|                |                          |
|----------------|--------------------------|
| J. John.       | W. S. Hart.              |
| B. Ahmad.      | M. A. Maqsud.            |
| C. M. Umar.    | N. Rajasekharan.         |
| N. Alam.       | P. J. Jhaveri.           |
| S. Q. B. Shah. | Dated 6th October, 1941. |

5th November, 1941

|                       |                      |
|-----------------------|----------------------|
| A. B. Rau.            | S. Ranganathan.      |
| P. S. Rao.            | S. R. Rao.           |
| P. R. C. Reddy.       | V. C. Venkatachalam. |
| M. Ikram.             | C. N. J. Aiyannadar. |
| S. Z. Ahmed.          | V. D'Costa.          |
| P. S. M. Kumarevelu.  | A. M. Seshan.        |
| A. R. Natarajan.      | S. A. DeSouza.       |
| C. K. Rao.            | C. A. Martin.        |
| P. S. Menon.          | L. A. N. Greenway.   |
| P. Krishnamurthy.     | J. W. Meyers.        |
| C. Balakrishnan.      | G. N. Rodgers.       |
| J. S. Serma.          | G. L. R. Tapsall.    |
| G. H. Durairaj.       | R. F. Fleming.       |
| S. I. Gopalakrishnan. | C. H. Smith.         |
| A. K. Haridass.       | F. E. Buckler.       |
| P. V. Ramachandran.   | H. L. Francis.       |
| C. K. Ramchandrar.    | G. L. McDermott.     |
| S. R. Sarvothaman.    | N. V. M. Stevenage.  |
| M. S. Krishna Murthy. | J. B. C. deLemos.    |
| T. Devairakkam.       | D. J. Burnett.       |
| J. E. Abraham.        | G. F. Martinus.      |
| A. Balasubramanian.   | W. E. J. Ward.       |
| S. N. Ganapati.       | E. E. Vaughan.       |

6th November, 1941

|                    |                      |
|--------------------|----------------------|
| K. M. K. Mohammad. | C. R. Chandrashekar. |
| A. A. Appadorai.   | A. N. deMonte.       |
| K. T. R. Nair.     | C. F. Vieyra.        |

|                  |                  |
|------------------|------------------|
| M. D. Ramaswami. | J. S. P. Coutts. |
| J. R. K. Rao.    | A. B. Osborne.   |

J. E. Garson.

7th November, 1941

P. F. Fanaken. J. A. Amor.

8th November, 1941

|                    |                            |
|--------------------|----------------------------|
| H. C. Halge.       | R. J. F. Campbell.         |
| W. R. Kirkpatrick. | Dated 11th November, 1941. |
| J. M. Stirling.    | Dated 17th November, 1941. |

5th December, 1941

|               |                   |
|---------------|-------------------|
| K. N. Sastri. | D. H. Rajan.      |
| S. K. B. Ray. | K. Suryanarayana. |
| S. C. Maitra. | K. S. Grewal.     |

J. Singh.

R. B. Tulpule. Dated 6th December, 1941.

5th January, 1942

|                     |             |
|---------------------|-------------|
| B. R. Karnad.       | L. M. Hogg. |
| M. R. Dhamdhare.    | D. Bhatt.   |
| T. L. W. McCullagh. |             |

10th January, 1942

|                   |                 |
|-------------------|-----------------|
| C. Muthukrishnan. | S. Zacharias.   |
| M. V. Kurian.     | V. Gnanadikham. |

E. S. Linton.

P. P. Paulose. Dated 12th January, 1942.

(Relative rank)

To be Lieutenants (on probation)

5th August, 1942

|   |
|---|
| (Mrs.) Elisabeth Muriel McDonald.                       |
| (Miss) Margaret Therese D'Silva.                        |
| (Mrs.) Eleanor Hope Barrington. Dated 7th August, 1942. |

8th August, 1942

|   |
|---|
| (Miss) Amy Lucy Forbes Hankins.                                 |
| (Miss) Una Roy.   |
| (Mrs.) Chander Kanta Lal.                                       |
| (Miss) Hoskote Krishnasastri Nanjamma. Dated 11th August, 1942. |
| (Miss) Jannki Bai Vidur Raj. Dated 14th August, 1942.           |
| (Miss) Anna Matthew. Dated 17th August, 1942.                   |
| (Miss) Alice May Waters. Dated 18th August, 1942.               |
| (Miss) Sylvia Mavis Rapson. Dated 19th August, 1942.            |
| (Miss) Phyllis Balfour Bellhart. Dated 21st August, 1942.       |
| (Miss) Barbara May Burgess. Dated 24th August, 1942.            |

PROMOTIONS

Captains to be Majors

|                 |                            |
|-----------------|----------------------------|
| C. J. H. Brink. | Dated 25th August, 1942.   |
| P. M. McSwiney. | Dated 5th September, 1942. |

The undermentioned Captains (on probation) are confirmed in their rank, with effect from the date specified :—

5th February, 1942

|                   |                     |
|-------------------|---------------------|
| F. M. F. Forrest. | S. N. C. Bona.      |
| H. K. Basu.       | D. N. Bhattacharya. |
| N. K. Mukherjee.  | D. C. Chaudhuri.    |
| S. A. Khan.       | T. S. Grewal.       |
| S. N. Basu.       | S. C. Banerjee.     |
| S. K. Sen.        | K. Pramanik.        |
| S. K. Ghose.      | A. N. Ray.          |
| A. C. Ghose.      | N. Thakkar.         |
| E. A. Shellim.    | K. Lal.             |

R. V. Padmanabhan.

INDIAN LAND FORCES

(Emergency Commissions)

Lieutenants to be Captains

S. C. Maitra. Dated 17th June, 1942.

23rd June, 1942

|                  |                 |
|------------------|-----------------|
| L. K. A. Ananta- | T. P. Durairaj. |
| narayanan.       | T. R. S. Row.   |

25th June, 1942

A. F. Hussain. I. Khan.

8th July, 1942

|                  |                    |
|------------------|--------------------|
| A. Raghavan.     | P. Raghunadharaju. |
| G. H. S. David.  | N. Vankataraman.   |
| N. Krishnaswami. |                    |

10th July, 1942

C. S. Mendiratta. J. Singh.  
D. R. Mendiratta. S. G. M. Shah.  
Nuruddin. M. K. Akhtar.  
C. K. Hasan.

5th August, 1942

A. N. deMonte. C. H. Smith.  
P. F. Fanaken. F. E. Buckler.  
S. A. DeSouza. H. L. Francis.  
C. A. Martin. F. E. Bedell.  
C. F. Vieyra. E. B. Woodhouse.  
J. S. P. Coutts. G. L. McDermott.  
A. B. Osborne. M. W. J. J. Pinto.  
H. T. Ince. E. M. Craggs.  
J. M. Stirling. J. E. Garson.  
L. A. N. Greenway. L. A. B. Matthews.  
H. C. Halge. N. J. C. deLemos.  
T. Lazaro. N. V. M. Stevenage.  
J. W. Meyers. J. F. Mason.  
R. J. F. Camprell. L. T. Lushington.  
R. Mascarenhas. J. B. C. deLemos.  
J. A. Amor. D. J. Burnett.  
B. A. Irvine, M.B.E. O. F. Paise.  
G. N. Rodgers. G. F. Martinus.  
G. L. R. Tapsall. G. E. J. Burby.  
R. F. Fleming. W. E. J. Ward.

W. R. Kirkpatrick.

D. H. Dracup. Dated 6th August, 1942.

*Lieutenants (on probation) to be Captains  
(on probation)*

15th January, 1942

R. Nagendran. P. N. Banerjee.  
G. V. S. Murthi. Dated 16th January, 1942.  
V. R. Thayumanaswami. Dated 29th January, 1942.  
C. K. P. Menon. Dated 2nd February, 1942.  
C. K. P. Rao. Dated 3rd February, 1942.  
R. Vishwanathan. Dated 4th February, 1942.  
G. P. Rayen. Dated 5th February, 1942.  
D. D. Boovariwala. Dated 12th February, 1942.  
A. F. Lasrado. Dated 15th April, 1942.  
P. A. Mathew. Dated 2nd May, 1942.  
R. A. Davar. Dated 19th May, 1942.  
M. A. Sami. Dated 4th June, 1942.  
M. Zia-Ullah. Dated 22nd June, 1942.

3rd July, 1942

S. K. Chakravarti. S. K. Dutta.  
B. S. Dutt. S. N. Sinha.  
R. M. Dastur. M. A. G. Bhutty.  
M. L. Datta. J. C. Sharma.

J. N. Karande.

4th July, 1942

S. M. K. Wasti. N. K. Basu.  
K. Somayya. Dated 5th July, 1942.  
T. K. Raju. Dated 9th July, 1942.  
J. Nichani. Dated 13th July, 1942.  
H. A. Bali. Dated 16th July, 1942.

5th August, 1942

G. B. Smart. E. T. Garthwaite.  
J. W. Cazalet. B. A. Hoogewerf.  
R. C. P. Thomas. P. J. Fonceca.

*Note.*—The seniority of Captain R. Bhattacharya in his present rank is antedated to 23rd November, 1934.

INDIAN LAND FORCES  
(Emergency Commissions)

(Dental Branch)

The undermentioned Lieutenants (on probation) are confirmed in their rank, with effect from the dates specified :—

P. C. Verman. Dated 5th March, 1942.  
S. Bratt. Dated 6th March, 1942.  
H. J. Kundanani. Dated 7th March, 1942.  
S. K. Gupta. Dated 8th March, 1942.  
C. M. Rego. Dated 9th March, 1942.  
H. J. Lobo. Dated 10th March, 1942.  
G. L. Narula. Dated 20th March, 1942.  
M. K. Sanjana. Dated 9th October, 1941.

*Lieutenants (on probation) to be Captains  
(on probation).* 21st November, 1941

I. Singh. Dated 4th October, 1938.

23rd February, 1942

K. S. Jolly. Dated 23rd February, 1938.

5th March

B. R. Joshi. Dated 5th April, 1940.  
M. M. A. Jabbar. Dated 3rd May, 1937.  
J. K. Andranvala. Dated 25th July, 1937.  
S. C. Sen Gupta. Dated 6th October, 1937.

6th April, 1938

K. S. Srinivasa. S. B. Jathar.  
M. S. Datta. S. N. Das.  
P. K. Dhar. B. G. Sarnabat.  
T. J. Gupta. B. R. Irani.  
S. N. Saha. J. P. Chotnia.  
D. V. Bapat. 22nd October, 1939.  
L. K. Kale. Dated 26th August, 1940.  
J. R. Shah. Dated 27th August, 1940.  
S. D. Ray. Dated 12th November, 1940.  
H. K. Mallick. Dated 4th October, 1941.  
S. K. Nandy. Dated 1st November, 1941.  
B. B. Sarkar. Dated 4th January, 1942.  
L. W. Ashton-Rose. Dated 5th March, 1942.  
F. H. McCay. Dated 5th September, 1936.  
A. M. Kerr. Dated 5th March, 1938.  
G. A. Ransome. Dated 11th April, 1942.

16th July, 1942

J. John. W. S. Hart.

N. Rajasekharan.

S. K. Ray. Dated 17th July, 1942.

24th July, 1942

B. Ahmad. N. Alam.  
C. M. Umer. M. A. Maqsd.

P. J. Jhaveri.

S. Q. B. Shah. Dated 25th July, 1942.  
P. S. M. Kumaravelu. Dated 31st July, 1942.  
D. H. Rajan. Dated 16th August, 1942.  
V. D'Costa. Dated 9th August, 1942.  
C. Krishna Rao. Dated 10th August, 1942.

24th August, 1942

K. S. Grewal. J. Singh.

R. B. Tulpule.

The undermentioned Lieutenants (on probation) are confirmed in their rank, with effect from the dates specified :—

5th February, 1942

S. K. Ray. S. P. Mehta.  
A. K. Chatterjee. J. Din.  
M. Y. Ghaznavi. S. K. Mukherjee.

H. L. Chhabra.

J. S. Sarkaria. Dated 6th February, 1942.  
N. S. Khan. Dated 7th February, 1942.

(Dental Branch)

The undermentioned Lieutenants (on probation) are confirmed in their rank, with effect from the dates specified :—

5th November, 1941

G. L. McDermott. D. J. Burnett.  
N. V. N. Stevenage. G. F. Martinus.  
J. B. C. de Lemos. W. D. J. Ward.

E. E. Vaughan.

J. E. Garson. Dated 6th November, 1941.  
R. Mascarenhas. Dated 7th November, 1941.  
W. R. Kirkpatrick. Dated 11th November, 1941.  
O. F. Paise. Dated 21st November, 1941.

5th December, 1941

F. E. Bedell. T. Lazaro.

6th December, 1941

H. T. Ince. B. A. Irvine.

Lieutenants (on probation) to be Captains (on probation), 5th March, 1942, with seniority from the dates shown against each.

L. R. S. Deo. Dated 20th March, 1937.

5th March, 1938

N. Subramanyan. V. S. Bhattal.  
M. Ray.

6th March, 1942, with seniority from the date shown against each :—

|                  |                             |
|------------------|-----------------------------|
| A. N. Das Gupta. | K. R. Unger.                |
| A. K. Ray.       | S. C. Driver.               |
| R. C. Mitra.     | H. Chatterjee.              |
| M. G. K. Menon.  | A. Kidvai.                  |
| K. N. Gubbar.    | S. Sankaran.                |
| M. N. Hukku.     | N. B. Banerjee.             |
| D. N. Parakh.    | Dated 6th September, 1937.. |

6th March, 1938

H. B. Mallick. S. C. Lahiri.  
N. H. Oonvala.

S. P. Chatterjee. Dated 8th March, 1942, with seniority from 8th March, 1938.

#### LAND FORCES

##### INDIAN MEDICAL SERVICE

##### (Emergency Commissions)

Lieutenants (on probation) to be Captains  
(on probation)

C. G. Muller. Dated 5th May, 1942.  
M. Seager. Dated 30th January, 1942.

11th May, 1942

B. J. Niall. Dated 8th April, 1937.  
L. Rich. Dated 2nd May, 1938.  
G. L. L. Reynolds. Dated 18th June, 1941.  
B. Rowlatt. Dated 4th May, 1942.

14th June, 1942

J. L. Roberts.

9th April, 1942

A. T. George. Dated 13th April, 1937.  
I. Chand. Dated 14th December, 1939.  
L. M. Ram. Dated 26th April, 1942.  
A. S. Sen. Dated 11th May, 1942.  
F. N. Kapadia. Dated 5th March, 1942.  
T. M. Nair. Dated 12th March, 1942.  
M. U. Hayat. Dated 13th March, 1942.

6th April, 1942

M. Habibullah. S. Y. Torné.  
N. C. Datta. Dated 7th April, 1942.  
H. D. Mukerjee. Dated 8th April, 1942.

5th May, 1942

|                   |                    |
|-------------------|--------------------|
| B. D. Gupta.      | P. V. Kurian.      |
| M. N. Razdan.     | K. L. George.      |
| N. C. Mehta.      | R. D. Irani.       |
| B. L. Nayyar.     | S. S. Najir.       |
| G. K. Mitra.      | H. S. A. Malik.    |
| A. W. Lisboa.     | S. N. Seal.        |
| S. S. Grewal.     | N. K. Basu.        |
| S. Gopalaswami.   | B. De.             |
| N. K. Acharyya.   | D. L. De.          |
| N. C. Banerjee.   | P. B. Coppiker.    |
| R. K. Mitra.      | B. S. Khangura.    |
| S. V. Tilak.      | J. K. Gharpure.    |
| K. Banerjee.      | S. B. Mitra.       |
| P. K. Mukerjee.   | N. G. Mukerjee.    |
| K. H. Bhadbhade.  | A. K. Ray.         |
| A. K. Mitra.      | B. K. Banerjee.    |
| R. S. Saha.       | S. N. Ahmed.       |
| M. R. Beg.        | S. A. Ali.         |
| L. S. Zuzarte.    | D. L. Bhagwai.     |
| G. P. Sathe.      | J. Singh.          |
| H. C. Dhawan.     | P. C. Basu.        |
| B. V. Shirolkar.  | B. P. Das Gupta.   |
| H. K. Mitra.      | A. Mascarenhas.    |
| B. N. Chatterjee. | A. M. Khan.        |
| H. DeSouza.       | G. Venkataramniah. |
| N. C. Ghosh.      | N. Narayanan.      |
| A. G. Chaudhuri.  | H. P. Rao.         |
| B. G. Sur.        | M. G. Prabhu.      |

N. K. Sen.

#### RETIREMENTS

Lieutenant-Colonel R. V. Morrison. Dated 1st September, 1942.

Lieutenant-Colonel B. T. Eminson. Dated 24th September, 1942.

Lieutenant-Colonel J. C. De. Dated 23rd August, 1942.

Major A. W. West. Dated 13th May, 1942.

## Notes

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THE British Drug Houses Limited have sent us a copy of their recently published price list of medical and miscellaneous products, injections, pharmaceutical specialities and tablets. The list is concise and simple and will be found useful for reference. Its pages show at a glance the names of the preparations with short descriptive notes, indications, methods of administration, packings and prices. There are also two useful indexes—one of diseases and another of medical products. Medical practitioners who have not received copies of the list may apply to the Firm, Imperial Chemical House, Ballard Estate, Bombay.

### BOVRIL LIMITED

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## Original Articles

### OBSERVATIONS ON INGUINAL HERNIA, ITS TREATMENT AND OPERATIVE TECHNIQUE

By F. A. B. SHEPPARD, O.B.E., F.R.C.S.  
MAJOR, I.M.S.

Professor of Surgery, and Principal, Andhra Medical  
College, Vizagapatam

THE subject of inguinal hernia is one of some antiquity and there are constant references to it throughout the whole period of surgical literature. Nevertheless a proper understanding of the underlying causes and the principles of treatment were not arrived at until the end of the 19th century. Since then a considerable variety of procedures, aimed at so-called repair of the inguinal canal, has been described. This insistence on adequate surgical repair of the region implies that the risk of recurrence is always with us. Despite this implication, it is curious to find that cases of inguinal hernia are frequently relegated to the end of the surgical list for unsupervised operation by a junior house-surgeon. In these circumstances, operative treatment is apt to become a matter of determination rather than of skill, and to result in a large recurrence rate. Statistics collected from groups of public hospitals have been collected from time to time to show a recurrence rate which compares most unfavourably with that of individual surgeons especially interested in the subject. For example, Max Page (quoted by Keynes), during an investigation of a selected group of individuals (policemen), found a post-operative recurrence rate of 20 per cent for indirect inguinal hernia, and 25 per cent for direct inguinal hernia, whereas Keynes himself had only 4 recurrences (two in one patient who had 'enormous' bilateral hernia but who had undergone sudden violent exertion soon after operation) from amongst a group of 94 of his own patients.

It is obvious that the subject is a difficult one calling for a thorough understanding of the inguinal region and for an individualized care of the patients.

#### *The inguinal canal*

The key to the problem of hernia lies in the inguinal canal, and a thorough understanding of its anatomy and its normal mechanism are essential. The canal is an oblique channel in the abdominal wall, in the adult about  $1\frac{1}{2}$  inches long, through which the spermatic cord passes down to the scrotum. In the infant up to the age of 2 years, the canal is so short that the internal abdominal ring almost underlies the external abdominal ring. Gradually, however, the length and obliquity of the canal increases until the internal abdominal ring comes to lie

at a point approximately half an inch above the middle of the inguinal ligament. The external ring remains opposite the pubic crest.

The internal abdominal ring is a structure of considerable importance.—The vas deferens, spermatic vessels and lymphatics which form the spermatic cord enter the inguinal canal and leave the abdomen through it. From the margins of the 'ring' which is a somewhat oval slit in the *fascia transversalis*, fibres are prolonged down the cord as the *internal spermatic fascia*. The size of the ring is a matter of considerable importance, for any increase in its size must necessarily weaken the posterior fibrous wall of the canal to a degree which varies with the extent of the enlargement. It is evident that the presence of an indirect inguinal hernia, which leaves the abdomen through the ring, will inevitably exert such an effect. In fact, cases are frequently observed in which this has proceeded to such an extent that the posterior fibrous wall of the inguinal canal can hardly be considered to exist at all. *Attention to the internal ring, and its restoration where necessary to a normal size, must be considered an essential step in all operations for indirect hernia.*

The posterior wall of the inguinal canal consists entirely of the *fascia transversalis*, reinforced medially by a lateral expansion of the tendon of insertion of the *rectus abdominis* muscle along the pectinial line of the pubic bone. This expansion is somewhat variable in length. Thus muscle fibres play no part in the make-up of the posterior wall.

The roof of the inguinal canal is formed by the arched fibres of the internal oblique as they pass from their origin along the outer half or two-thirds of the inguinal ligament to their insertion into the *linea alba* and the pubic tubercle. The *transversalis* muscle is usually fused with the internal oblique in this situation and cannot be separately defined from it. The internal oblique muscle is of great importance for it protects the internal ring, and has an important sphincter-like action on the inguinal canal as a whole, for when it contracts the arch straightens out and approximates itself to the inguinal ligament. The significance of this muscle and the importance of preserving it intact was stressed by Hamilton Russell forty years ago.

The conjoined 'tendon' consists mainly of muscle fibres of the fused internal oblique and transversalis muscle approaching their attachment to the pubic bone.

The *cremaster muscle* is a part of the internal oblique muscle continued down the anterior aspect of the cord as a series of looped fibres. These muscle fibres of the cord can, in nearly every case, be seen to have an attachment of variable strength to the more medial end of the inguinal ligament. In effect, therefore, there are muscle fibres attached to the inguinal ligament throughout practically the whole length of the inguinal canal, viz, the internal



oblique muscle and its continuation, the cremaster muscle. The fibres of the cremaster muscle continue down the cord for a variable length and then loop upwards to rejoin the internal oblique just before its attachment to the pubic tubercle. On incising and opening out the external oblique aponeurosis through the full length of the inguinal canal, in operating for inguinal hernia, the underlying space is seen to be occupied by muscle fibres which, in the area between the *rectus abdominis* muscle and the cord, show a varying degree of development. In early cases of indirect hernia, it is so much the rule for these muscle fibres to show a full development, that such may be taken to be the normal arrangement. It has been noted, however, in the few cases of Malgaigne's swellings operated upon, and in all those cases of direct hernia with an overlying, stretched but otherwise intact layer of *fascia transversalis*, that the muscle in the area referred to is greatly thinned, and in some cases even entirely absent. It is difficult to assert that this absence of normal development is of congenital origin, for it may often represent a pressure atrophy of muscle fibres superimposed on the underlying hernia. Since, however, the earliest response of muscle to strain is an hypertrophy, and as such has never been observed at operation on really early cases of hernia of this type (*i.e.*, direct hernia covered by a bulging *fascia transversalis*), I am inclined to the view that a congenital deficiency in the region does in fact play an important rôle in the development of certain varieties of direct hernia. Attention should be given to this region in all exposures of the inguinal canal, and the degree of muscle development should be noted. Should it be poor, even in early cases of indirect hernia, the necessity for a reinforcement operation in addition to a simple excision of the sac would be indicated on the assumption that such patients are liable to the later development of a *direct* hernia.

The anterior wall of the inguinal canal is particularly strong, for it is in reality formed by the internal oblique muscle for part of its extent, and by the cremaster muscle, as well as by the aponeurosis of the external oblique muscle. The external abdominal 'ring' is a triangular opening through which the cord covered by cremaster fibres passes to the scrotum, and is situated just above and lateral to the pubic crest, and precisely opposite to the lateral expansion of the tendon of insertion of the *rectus abdominis* muscle which reinforces the extreme medial end of the posterior wall of the canal. In operation for the relief of hernia, the normal size of the ring should be restored in order to preserve the full strength of the inguinal canal.

The inguinal ligament of Poupart forms the floor of the canal. As it is firmly attached to the *fascia lata* of the thigh, it forms a useful and reliable sheet-anchor in all reinforcement procedures for strengthening the inguinal canal.

### *Ætiology*

The occurrence of two main varieties of inguinal hernia has long been recognized, the *indirect* hernia which enters the inguinal canal through the internal abdominal ring, and the *direct* hernia which enters the canal through its posterior wall. The essential differences between these two varieties are of great importance and have a bearing on treatment and prognosis.

1. *Indirect inguinal hernia* depends for its occurrence on the presence of a preformed congenital sac. This is the basic conception of the origin of all such hernias. The process of peritoneum which accompanies the testicle in its passage through the inguinal canal to the scrotum, is normally obliterated entirely except for that portion which surrounds the testicle. In certain cases its obliteration up to the internal abdominal ring is incomplete, or fails to occur at all, and there remains a patent process of peritoneum which extends for a variable distance down to the testicle. As no amount of force or trauma has ever been shown to result in the escape of a process of peritoneum and intra-peritoneal contents through the internal abdominal ring, the congenital origin of indirect hernias may be assumed with some confidence. The unvarying situation of the sac within the spermatic cord, its direct relationship to the *vas deferens* which *always* lies closely applied to it *posteriorly*, the frequency with which thickening and signs of obliteration are to be observed at the apex of hernial sacs, and especially of that variety of sac which extends down to and invests the testicle, all these findings supply strong evidence of its congenital nature. The fact that most indirect hernias do not occur until early adult life is due to the anatomy of the inguinal canal, which even in the presence of an unobliterated peritoneal process is able effectively to resist the escape of gut or omentum into it. To most individuals with such a sac, however, a time is sure to come when gut or omentum will enter it, either suddenly, as a result of unexpected or overwhelming strain, or insidiously. Once such an event has occurred, the walls of the sac are opened out and the inguinal canal operates under an ever-increasing disadvantage. Furthermore, the posterior wall of the inguinal canal is greatly weakened by the stretching and dilatation of the internal abdominal ring which follows the birth of the hernia. It has been noted previously that this dilatation of the internal ring may progress to a degree which amounts to almost complete destruction of the posterior wall of the canal. The protective sphincter-like control of the internal oblique muscle is similarly lost in time through stretching of the muscle fibres. The overlying aponeurosis of the external oblique muscle is also progressively stretched and the external abdominal ring dilated, with increase in the size of the hernia. A vicious circle is thus established. With the passage of the internal ring medially and the external ring laterally, a

time may come when the patient has an aperture in his abdominal wall which will admit directly two or more fingers.

2. *Direct inguinal hernia.*—The important essential difference between this variety of hernia and the indirect variety is the absence of a preformed sac: The hernia thus depends for its occurrence on (a) a weakness of the inguinal canal, either developmental or acquired or (b) on an actual rupture of, or aperture in, the fibres of the *fascia transversalis* forming the posterior wall of the canal.

These important differences, which have not always been clearly defined or recognized, require further consideration.

(a) *Primary weakness of the inguinal canal, congenital or acquired.*—Reference has already been made to Malgaigne's swellings in which has been observed a poor development of muscular tissue in the area between the rectus abdominis muscle and the cord. A similar poor development is occasionally observed in patients operated on for indirect hernia too early in origin or too small to have caused secondary weakness.

The general bulge of the lower abdomen which occurs with increasing age is evidence of a loss of postural tone of the lower abdominal musculature. The protective efficiency of the muscles guarding the inguinal canal is thus reduced, so that any increase of intra-abdominal pressure such as is brought about by intra-abdominal adiposity, a chronic persistent cough, the straining of constipation or of urinary difficulties, is apt to lead to a bulge forwards of the poorly protected posterior wall of the canal, and to the development of a direct hernia. In hernias consequent on primary weakness of the inguinal canal, the sac is always covered by the greatly stretched and bulging *fascia transversalis* of the posterior wall of the canal. It is thin-walled, it never descends into the scrotum and in consequence of its wide neck has little, if any, tendency to strangulation. In the aged, it is characteristically bilateral.

(b) *Rupture of the posterior wall of the canal.*—Direct hernias are seen in which the sac has clearly come through an aperture in the posterior wall of the canal. The margins of the aperture are well defined, and it is constantly situated close to the lateral border of the *rectus* muscle. This constant situation of the aperture, and the unlikelihood of any force from within the abdomen rupturing an intact posterior wall, point to its congenital origin. The sac is not covered with *fascia transversalis*; it is thin-walled and may be surrounded by a considerable mass of extra-peritoneal fat. In one case, an asthmatic, admitted with severe pain and tension in the swelling, and operated on urgently, the mass of extra-peritoneal fat was in a condition of strangulation, the hernial sac being congested but empty. Such hernias are usually unilateral, and occur in young men. It is of importance to note that the narrow neck of the

sac and the rigid margins of the opening through which it emerges, predispose the patient to the risk of strangulation. This variety is relatively uncommon and is usually indistinguishable pre-operatively from an indirect hernia.

### Treatment

*Indirect inguinal hernia.*—In all cases, provided general and local considerations permit, early operation should be advised. The narrow neck of the sac which exposes the patient to the constant risk of strangulation, and the fact that with increase in the age and size of the hernia the muscles of the inguinal canal are progressively weakened, are the two factors which dominate the situation.

In patients suffering from gross cardiac or renal insufficiency, operation must, of necessity, be avoided unless there is reason to fear the onset of strangulation, or unless strangulation has actually occurred. The hernia in such patients must, ordinarily, be controlled by a truss which should be carefully measured and adjusted by the surgeon, and its efficiency constantly checked. Operation also is best postponed, if possible, in infants up to the age of two years, for not only are the tissues delicate and less easy to define, but the lack of urinary control increases the risk of wound sepsis. The question of fitting a truss to an infant should receive consideration, for there is reason to hope that, at least up to the age of one year, obliteration of the sac may still occur. Such consideration should only be given if the parents are sufficiently intelligent to grasp the rules of application of the truss, and to appreciate the necessity for cleanliness. There will therefore be many cases in which operation will have to be performed, even in infancy. Fortunately, in infants the surgical procedure necessary for the cure of the hernia is minimal, complete removal of the sac being all that is required. The shortness of the inguinal canal renders it possible to do this without incising the external oblique muscle. In all other cases up to the age of twenty-five years, in addition to complete removal of the sac, it is necessary carefully to define and examine the internal abdominal ring, and to reduce it by suture to a normal size, snugly enclosing the spermatic cord.

In judging whether reinforcement of the posterior wall of the inguinal canal is a further necessity, the age and occupation of the patient, as well as the age and size of the hernia, and also the actual appearance of the muscles, internal oblique and cremaster, as seen at operation, have all to be taken into account. All adult labourers and, generally speaking, most patients over the age of thirty, will require reinforcement and 'repair' of the inguinal canal, for while removal of the sac and closure of the internal abdominal ring to a normal size will guarantee cure of an indirect hernia, the presence of primary or secondary muscular weakness predisposes the patient to the later development

of a direct hernia. A few hernias are encountered of such a gross size that destruction of the inguinal canal has reached a degree where cure can be obtained only by castration and obliteration of the canal.

### Direct hernia

(a) *Primary weakness of the inguinal canal.*—When this variety of hernia is seen in 'pot-bellied' old men, operative treatment is often not advisable. The hernia is caused by loss of tone of the lower abdominal musculature plus the increasing intra-abdominal pressure of age. These causes are for the most part irremediable. Moreover, it never reaches a large size and, by virtue of its wide mouth, never strangulates. The fitting of a truss is preferable to an operation for such patients, and provided that care is taken with regard to its efficiency, the hernias will be completely controlled. In the less common cases in which the hernia is unilateral and has occurred in middle aged or younger patients, operation is worth while. The redundant and stretched *fascia transversalis* enclosing the thin-walled sac should be excised, but the sac itself need not be removed. Reinforcement of the posterior wall of the canal is the essential step in such cases.

(b) *Rupture of the posterior wall of the inguinal canal.*—Such hernias occur in relatively young men, are unilateral and relatively rare. Early operation is a necessity in all cases of this nature, for the narrow neck predisposes the hernia to strangulation. If the overlying muscular development is good, and the hernia is of recent origin, removal of the sac and closure of the aperture through which it has come are all that is required. If muscular development is poor, or secondary weakness is judged to be present, further reinforcement of the posterior wall of the canal will be necessary.

### Technique

Operation for hernia requires a delicacy of execution which it does not always get. Exposure of the sac should be achieved by a deliberate dissection with the knife through each successive layer of tissue. It is then possible to lift up the sac and clear it of internal spermatic fascia with a minimum of destruction to the tissues. The internal spermatic layer of fascia is often so closely adherent to the sac in the region of its neck that a few touches with the knife are necessary in order to effect its complete clearance, and to define clearly the internal abdominal ring. It would seem unnecessary to mention the need for a complete opening of the inguinal canal (in all but infants) by an adequate incision of the aponeurotic external oblique muscle, but for the fact that operations have been witnessed in which no attempt was made to open the canal at all. The inguinal canal must be opened for its full length in order to permit inspection of the underlying muscle tissue and to allow complete

exposure of the sac. In many cases, in addition to the original indirect hernial sac, it will be found that superimposed secondary weakness of the canal has resulted in the formation of a small direct hernia.

### DESCRIPTION OF PLATES XXXII AND XXXIII

Fig. 1.—The external oblique aponeurosis has been freely incised to show the underlying internal oblique and cremaster muscles. The ileo-inguinal nerve is not shown and, as illustrated, the incision in the external oblique is somewhat longer than necessary. Note that the cord and any hernial sac are covered by muscle tissue. The varying degree of development of this muscle tissue and its importance have been noted in the text.

Fig. 2.—The cremaster muscle and its fascia have been incised to display the underlying cord and fascia. An indirect hernial sac lies immediately beneath the muscle. A direct sac will lie above and medially to the cord.

Fig. 3.—An indirect sac has been transfixed and ligatured at its neck. Note the moderately dilated internal abdominal ring.

Fig. 4.—The sac has been excised. The internal oblique muscle is retracted upwards to fully display the internal ring.

Fig. 5.—The internal ring is being reduced to a size snugly enclosing the cord, by a continuous suture (of fine silk or nylon).

Fig. 6.—The suture of the internal ring has been completed. In hernia in which no further repair than this is considered necessary, the cord would not be displaced (as shown also in figures 3, 4 and 5). It would be left undisturbed, and the operation completed by suturing the cremaster muscle back in front of it, and by similarly suturing the external oblique muscle.

Fig. 7.—The less common variety of direct hernial sac proceeding through an aperture in the posterior wall of the inguinal canal is shown, transfixed and ligatured.

Fig. 8.—The aperture in the posterior wall of the inguinal canal is in process of being closed with a continuous suture (of fine silk or nylon). In early cases with well-developed internal oblique and cremaster muscles no reinforcement would be required. The operation would be completed by suture of the cremaster muscle in front of the cord.

Fig. 9.—In cases requiring reinforcement the cremaster muscle is sutured behind the cord. Unless this is done it is not possible to bring down the upper leaf of the external oblique muscle to the inguinal ligament, without injury to or destruction of the cremaster muscle.

Fig. 10.—The upper leaf of external oblique muscle is in process of approximation to the inguinal ligament for the full length of the inguinal canal, the first and most medial suture passing through the thickened periosteum of the pubic tubercle. A continuous silk or nylon suture is used.

Fig. 11.—The suture completed, the cord has been allowed to drop back into place.

Fig. 12.—The inguinal canal, with two layers of tissue added to its posterior wall, is reconstituted by suture of the lower leaf of external oblique muscle to aponeurosis above the cord.

PLATE XXXII  
OBSERVATIONS ON INGUINAL HERNIA, ITS TREATMENT AND OPERATIVE TECHNIQUE :  
F. A. B. SHEPPARD

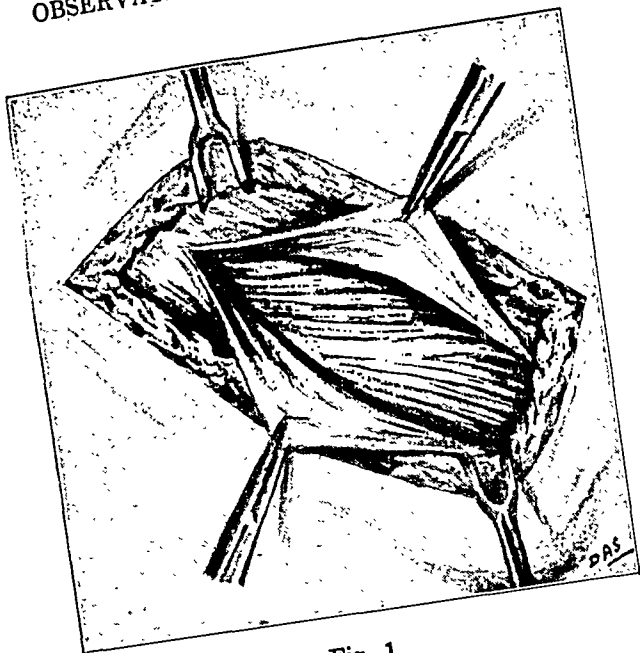


Fig. 1.

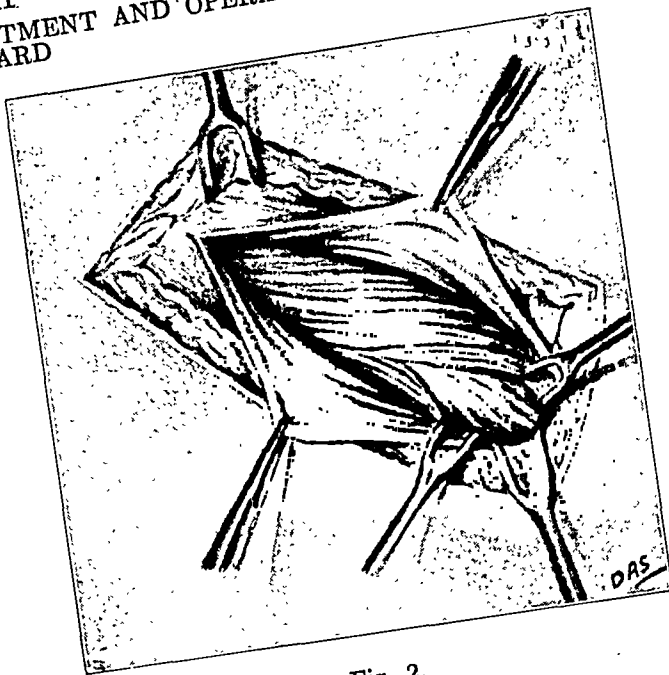


Fig. 2.

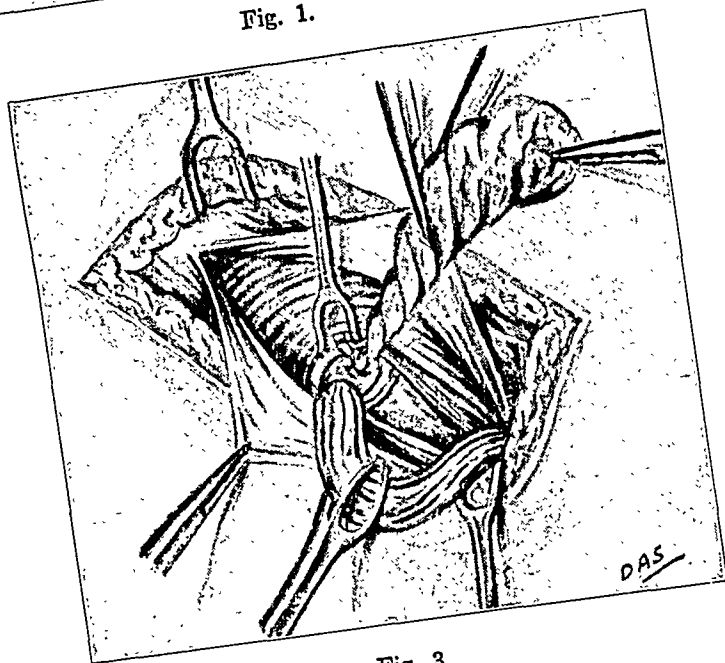


Fig. 3.

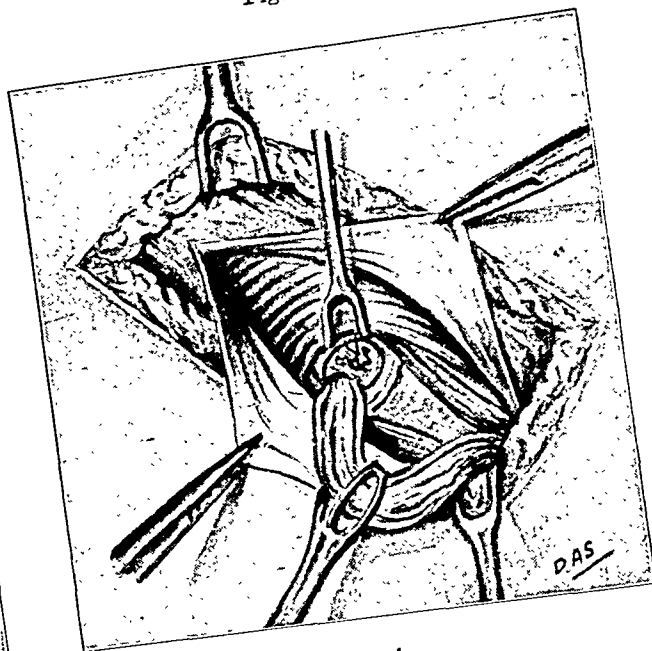


Fig. 4.

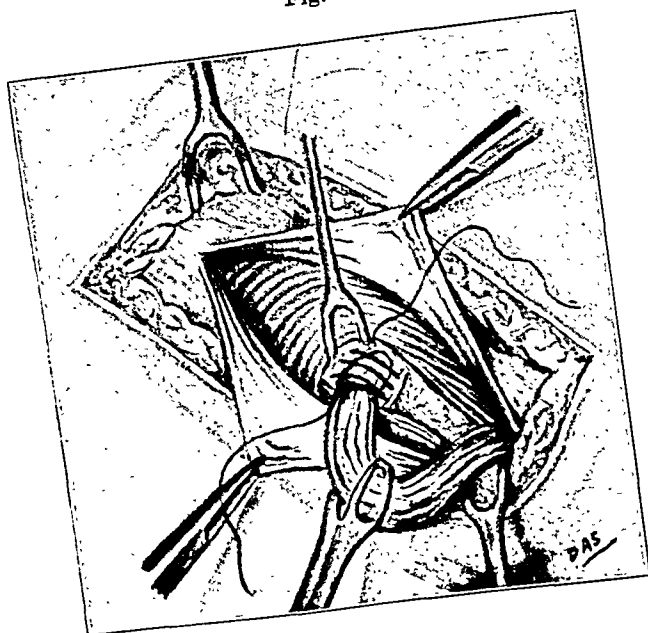


Fig. 5.

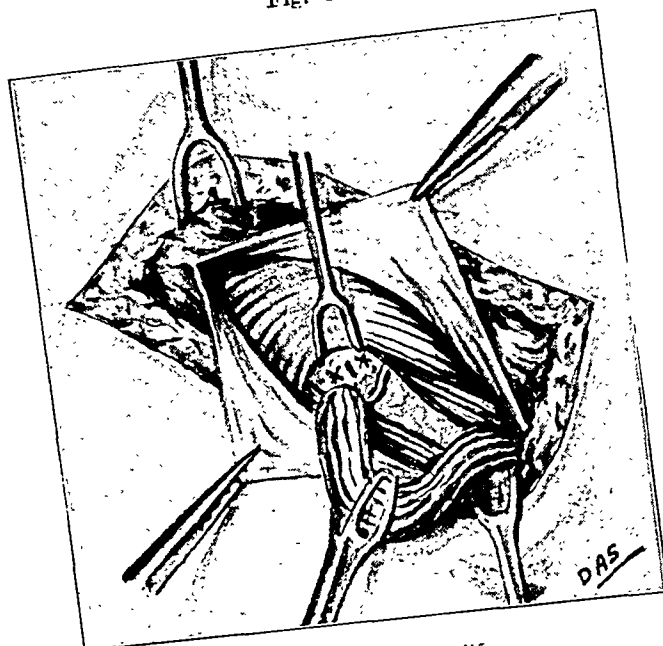


Fig. 6.

PLATE XXXIII  
OBSERVATIONS ON INGUINAL HERNIA, ITS TREATMENT AND OPERATIVE TECHNIQUE:  
F. A. B. SHEPPARD

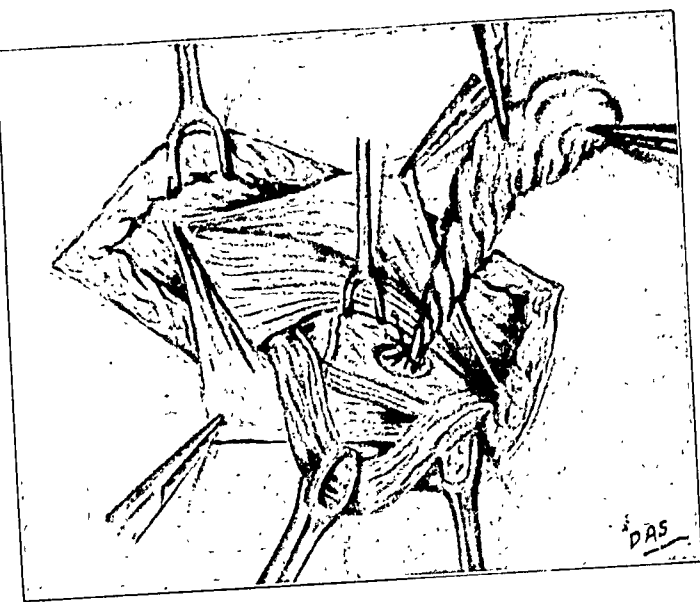


Fig. 7.

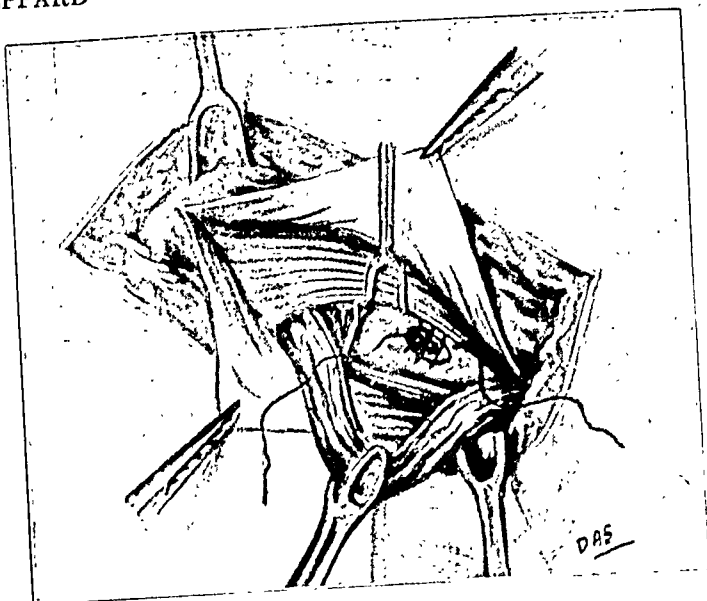


Fig. 8.

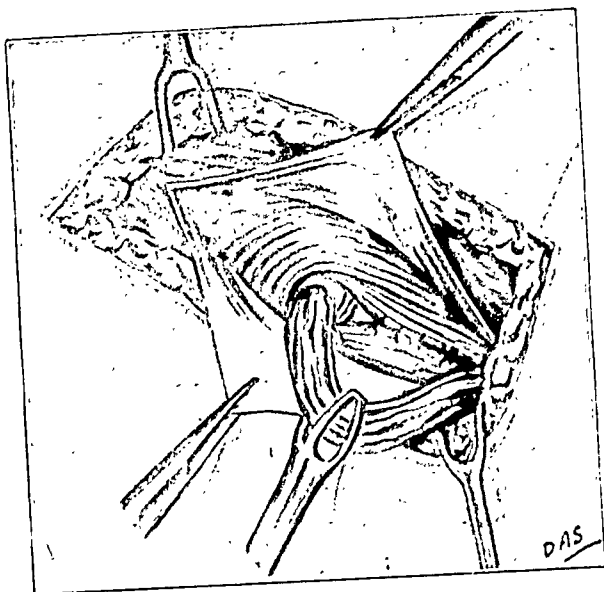


Fig. 9.

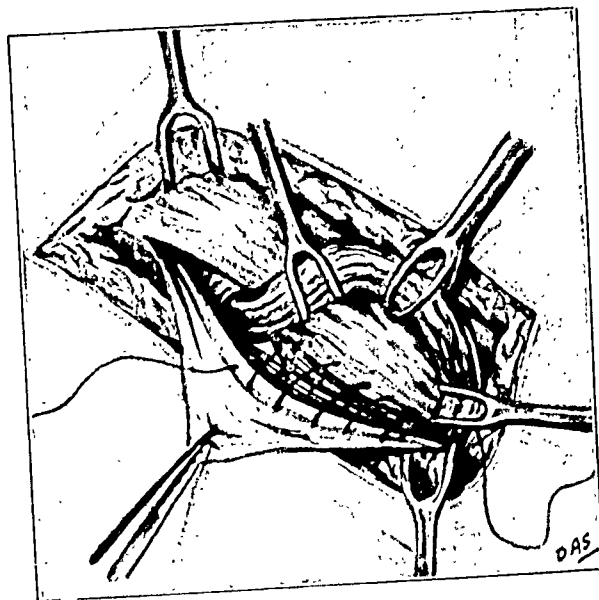


Fig. 10.

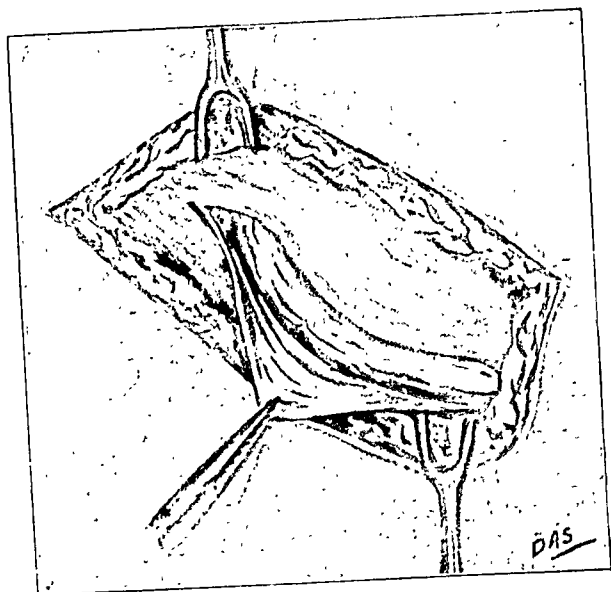


Fig. 11.

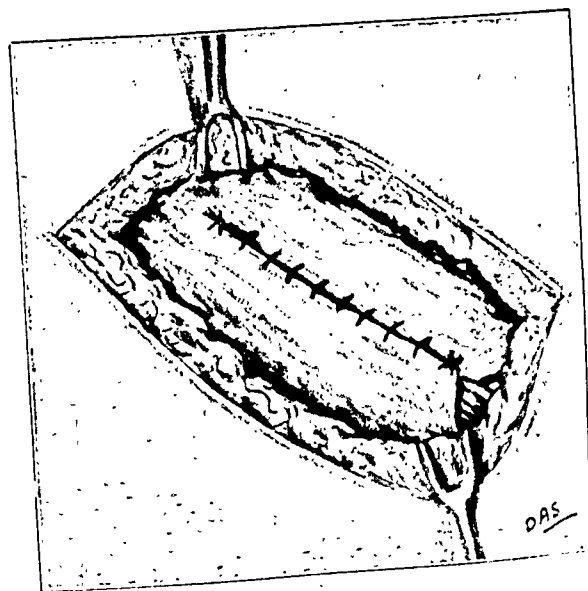


Fig. 12.

Many variation in technique for the reinforcement of the posterior wall of the inguinal canal are in use, the most popular being the use of free fascial sutures derived from the thigh, a flap of rectus sheath, or 'darning' with silk sutures. The Bassini operation in which the internal oblique muscle is sutured to the inguinal ligament is still commonly performed, but the support which it gives to the posterior wall of the canal is most unreliable. In most cases of recurrence following this operation, I have observed that the sac has found its way through a split in the fibres of the muscle, just above the site of its fixation to the inguinal ligament. The operation which I favour for the reasons that it is sound in principle and gives excellent results in practice, is based on that of Andrewes.

The inguinal canal is approached through a somewhat transversely oblique incision one inch above the inguinal ligament. The aponeurosis of the external oblique muscle is cleared of fat by a sweep of gauze and incised, so as to open out the inguinal canal for a little more than its full length. The internal oblique and the cremaster muscles are inspected and their development noted (figure 1).

In operation for indirect hernias, the cremaster muscle is then picked up with a pair of artery forceps and incised in the direction of its fibres and of the underlying cord, care being taken to avoid the ileo-inguinal nerve, which is subsequently retracted to one or other side (figure 2).

Incision of the thin internal spermatic fascia then enables easy dissection and delivery of the sac, which is twisted off, transfixed at its neck, and excised (figure 3).

If the neck of the sac is relatively wide-mouthed, a running suture of catgut is a preferable and more efficient means of closure than simple transfixion and ligature. Retraction of the internal oblique muscle upwards then enables the internal ring to be inspected and, if enlarged, reduced to a normal size with a silk suture. The importance of this manoeuvre, which restores the posterior wall of the canal to its normal degree of completeness, is again stressed (figures 4, 5 and 6).

In operation for direct hernia, incision in the thinned and poorly developed cremaster muscle is made over the site of the hernia, above and medial to the cord. In that variety in which the sac is covered by the stretched fascia transversalis of the posterior wall of the inguinal canal, the fascia is incised and the sac stripped off it, care being taken not to damage the bladder which is so often in close relation. Redundant fascia is then excised, and the edges are brought together with a fine silk suture. It is not necessary, and even inadvisable in most cases, to attempt excision of the sac, because it is so delicate that sutures simply cut out.

Where the hernia has passed through an aperture in the posterior wall of the canal, the

sac is, as before, defined by incision of the covering cremaster muscle, above and medial to the cord. It is then excised after transfixion of the neck in the usual manner (figure 7).

Sacs of this nature are sometimes enclosed in a considerable quantity of extra-peritoneal fat, which has to be carefully peeled off. The bladder also is occasionally in close relation in the region of the neck. The aperture in the posterior wall of the canal is next closed with a silk stitch. In early cases with good muscle development, no further repair is necessary (figure 8).

Should reinforcement of the posterior wall of the canal be deemed necessary for the reasons previously given, the cord is held aside with a Lane's forceps which encloses it and the cremaster muscle sutured behind it, so as to enable the upper leaf of the aponeurosis of the external oblique to be drawn down and sutured, also behind the cord, to the inguinal ligament for the full length of the canal (figure 9).

Approximation of the external oblique aponeurosis to the inguinal ligament is effected with a continuous suture of fine silk or nylon. It is considered essential that the first stitch be passed through the thickened periosteum covering the pubic tubercle so that no gap is left at the medial end of the canal through which a hernia may pass. In order to effect this, the upper leaf of the external oblique aponeurosis should be clearly defined, particularly in the region of the superior crus of the external abdominal ring. In this situation, the cremaster muscle is often to be observed closely adherent to the under-surface. Similarly the under-surface of the lower leaf of the external oblique has to be cleared down to the inguinal ligament, and especially medially so as to define the pubic tubercle (figure 10).

In practically every case the stretching already suffered by the external oblique aponeurosis through the presence of the hernia will permit its ready approximation without tension to the inguinal ligament. In the occasional instance where such approximation of the aponeurosis to the inguinal ligament could be effected only by the exercise of a certain amount of tension, the gap between it and the ligament should be bridged by a series of very closely placed silk sutures, to act as a darn and to supply the foundation for the development of firm fibrous tissue in the region. There are no real grounds for the view that retention and suture of the cremaster muscle behind the cord leave a gap medially through which a recurrent hernia may pass down along the cord. No such gap is left if the first suture passed through the external oblique is correctly placed. The further argument that posterior reposition of the cremaster muscle interferes with its function of drawing up the cord and testicle is of little importance. In adults this function is not apparent, and, furthermore, in practice no disability follows alteration in the position of the muscle.



Not only do I consider it wrong to excise the cremaster, but I regard its preservation and suture behind the cord as an additional protection to the posterior wall of the canal. As soon as the reinforcement of the posterior wall of the canal is completed, the cord is allowed to drop back into place, and the lower leaf of external oblique aponeurosis is sutured in front of it (figures 11 and 12).

Separate suture of the superficial fascia and the skin completes the operation. Hæmostasis should be perfect throughout.

This reinforcement technique has been employed in more than six hundred operations, and has given complete satisfaction. The addition of two layers of tissue, the cremaster muscle, and a leaf of the external oblique aponeurosis to the posterior wall of the canal can be considered to provide a most effective means of support. The extensive use of silk or nylon, which is considered the most satisfactory suture material in this type of operation, does not increase the incidence of wound sepsis, and only the ordinary rules of asepsis and pre-operative preparation, applicable to any surgical procedure, need be followed.

*Post-operative care.*—All adult patients should be confined to bed for twenty-one days following operation, and forbidden to resume heavy work, if such is their occupation, earlier than two months from the date of discharge from hospital. Sedentary workers may resume duty after one month. For patients with lax abdominal muscles, a course of simple strengthening exercises of the leg-raising or body-bending type should be prescribed. Any tendency to excess weight should be kept in check by attention to the diet and by suitable exercise.

*Recurrence.*—It has been found possible to maintain contact with only a few cases after discharge from hospital, and it is therefore impossible to form a really accurate opinion regarding recurrence. No case of recurrence following the above operative treatment has yet come to my notice. As is well known, conditions are such in India, that one should be certain to see at least some of the cases if recurrence was occurring in even 5 per cent. I therefore feel justified in holding the belief that the incidence of recurrence must be really low, provided a careful and individual study is made of each patient, and a meticulous attention to detail followed at operation.

#### Summary

The inguinal canal has been described with special reference to the surgical significance of each layer.

The underlying causes of each variety of primary hernia and the principles governing treatment are discussed.

An operative technique practised in a large number of cases has been described, and the conclusion is drawn that, provided an individual study is made of each patient and a strict

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## NOTES ON THE USE OF COTTON IN SURGERY, AND ON PLASTER TECHNIQUE

By A. T. ANDREASON, F.R.C.S.

MAJOR, I.M.S.

### (A) THE USE OF COTTON AS SUTURE AND LIGATURE MATERIAL IN PLACE OF CATGUT

IN the present crisis the supply of catgut is likely to become a problem, particularly when it is considered that so many different types are used for various types of work, and when it is realized that it is not prepared in any large quantity in India. A further difficulty with catgut is the elaborate manufacturing apparatus required to ensure a supply of any size and reliability.

Any material which will cause no more tissue reaction than catgut and which is available in good quantity, easily sterilized by boiling, available locally and requiring no extra factory installation than at present available would very certainly be an ideal material for general use in war time at least. Such criteria are fulfilled by cotton.

Cotton has been in use by reputable surgeons in various parts of the world, according to publications available at the moment, since 1913 when Halsted (1913) wrote on its use. From that time there has been a steady stream of literature on the use of cotton. A number of the more informative are listed for reference at the end of this note. The trend of the reports appearing since 1939 has been to show that cotton is in many respects more nearly the ideal suture material than is catgut.

Catgut seems to hold its place as a suture material on the basis of its being absorbable, and upon the teaching that foreign bodies are to be feared in wounds. It seems to have been forgotten that catgut itself is a foreign body and that it is one of those foreign bodies which will excite no mean reaction since it is absorbable. It has been shown experimentally that when catgut, silk, linen and cotton were carefully graded for the reaction they caused in tissues, catgut caused most reaction with the slowest healing and after it in order with less and less reaction and quicker healing were linen, silk and cotton (Meade and Ochsner 1939).

The ideal suture should be pliable, easily prepared, easily available, inexpensive, should tie securely, should not excite tissue reaction, should maintain its strength for a predictable length of time in all patients, should cause no tendency to infection or sinus formation. In my experience

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attention is paid to the operative detail, highly satisfactory results may be expected.

My thanks are due to Professor R. Krishna Rao and Dr. T. V. Mathew, of the Anatomy Department, for their help in dissections of the inguinal region, made in order to clear up certain points in the anatomy of the inguinal canal.

with all types of suture material, cotton most fully fulfils these requirements. Cotton is pliable, is available in any bazar, is easily sterilized by boiling for 20 minutes, and does not lose strength by reboiling, is inexpensive (400 yards for four annas), has a secure knot when properly tied, the ends may be cut on the knot without fear of the knot slipping, and has proved to be one of the most inert suturing materials that has so far come into use.

Cotton maintains its strength for a known predictable period in all patients. Its tensile strength is increased 10 per cent. after boiling for 20 minutes. When placed in the tissues it loses 10 per cent of its strength in ten days, which fact contrasts favourably with catgut which loses 50 to 70 per cent in ten days, and which will be absorbed more quickly in one patient than in another in an unpredictable manner.

Cotton shows a low incidence of infection and has not caused any tendency to sinus formation in infected cases.

My own experience of cotton extends over five years, including a large number of abdominal operations involving intestinal anastomosis and gastric resections in a centre where 20,000 new cases of peptic ulcer were seen each year, and where some 3,000 cases of intestinal obstruction were admitted yearly. I have used it in operations on the head and neck, and upon the extremities. I have come to use it exclusively for all surgical work, including suture of the kidney, ureter and bladder.

(a) The main points of the technique of the cotton suture are :—

1. Use interrupted sutures only except for the peritoneum.

2. Sutures are pulled only tight enough for comfortable approximation of the structures under suture. Tightness of the knot does not ensure more certainty of union, in fact it is the reverse. It must not be forgotten that catgut does not maintain its tensile strength for more than two or three days, whereas that of cotton is permanently maintained. Hence too tight a suture with cotton will lead to cedema and cutting out of the cotton; with catgut this will not occur since its strength is not maintained.

3. Never use buried absorbable and non-absorbable sutures side by side.

4. Always use the finest available material compatible with the strength required. Coarse material does not do well.

5. Avoid mass ligatures; pick up the very point to be ligatured.

6. Never leave enclosed dead space.

7. Always close the superficial fascia separately.

8. Use 40, 6 cord thread for all work. I have never used anything but 40, 6 cord, for all purposes, doubling it when extra strength was necessary.

9. Sutures are cut 18 inches long and threaded on needles ready for use, placed between layers

of lint or gauze and sterilized by boiling. A glass reel with some forty yards wound on it is also boiled for extra sutures and for ligatures. Cotton is always served up under saline in a tray or bowl, and kept wet until required for use.

10. Black cotton is used, for if white were used it would soon be invisible when once stained with blood.

11. All knots are so placed that they are directed downwards.

12. With the superficial fascia sutured the skin sutures may be removed in 24 to 48 hours in the face and neck, and in 5 to 6 days elsewhere.

13. Cotton may be used in contaminated wounds with as much safety as any other material. (The old surgical rule here is not to use any in the presence of sepsis whatever the material.)

14. Cotton is an excellent intestinal suture material provided that the three-layer technic is used. In this way the mucosa is never perforated by a suture appearing at the serous surface.

(b) The cotton knot is not tightened with a jerk, but by a steady and gentle sliding of the first turn into position at the point to be tied off with the two forefingers taking a steady strain in opposite directions on each of the two lengths of thread coming from the knot being tied. Once firmly and evenly tied the first turn will not slip unless it has become slippery in fat. Hence in general it is not necessary for more pull being maintained than that required to allow the second turn of the knot to be taken. This second turn should be tied and tightened in the same manner as the first.

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#### (B) A SIMPLE METHOD OF REMOVING PLASTER OF PARIS CASTS

Recently there have been described in the medical press several ingenious methods of removing plaster of paris casts. The following method does not appear to have been mentioned. It has the advantage in that it is applicable even under service conditions since no special gadget or appliance is required. All that is necessary is two lengths of rubber tubing of about 8 mm. external diameter and a little vaseline to grease

the tubing with. The tubing should be of such a length that it can be laid along the external aspect of a large adult thigh, leg and body from the axilla to the small toe with six inches over at each end. This is the longest cut required in any plaster cast. The tube should be kept this length and not cut for shorter plaster; its length in the shorter plasters is no disadvantage, and economy is observed by the need of only two lengths of tubing—one for each side of a double spica or a spinal cast—instead of many lengths for the many different sizes of plaster cast in use.

The method of application is as follows :—

(a) In an arm or a leg, the posterior slab having been laid in position, the site for the slit in the plaster, either for immediate slitting or for removal after the required period of immobilization, is chosen, and the vaselined rubber tubing is laid in that position and held by one or two turns of the wet bandage used for holding the moulded slab in place. The plaster is then completed as usual. After completion and hardening, the tubing is pulled tight and stretched at each end where it projects from the plaster, and in this way it is eased out of the cast. A tunnel is left of sufficient dimension to allow the toe of the plaster shears to be inserted freely without catching up the skin as the cutting progresses. The bends and angles are easy to cut by this method, and, if they are likely to be acute and difficult to turn with the shears, a little ingenuity in the placing of the tubing will give a less acute angle to cut through.

(b) In large lower limb casts involving the thigh and trunk the casts can be removed more easily if two tubes are inserted, one externally and one internally. The same applies to spinal casts.

(c) By using two tubes in suitable position any cast may be bivalved very rapidly.

I have used the method for over five years now with satisfaction. The idea may be of use in this present time when plaster is in such general use, and much time and energy are lost in the removal of heavy plasters put on to ensure that a case may be evacuated with safety.

#### (C) A SIMPLE METHOD OF PLASTERING A LIMB LIKELY TO SWELL

Treating an injured limb which is already swollen or is likely to swell is a serious problem to all who have the responsibility of treating injuries to limbs. In more normal times it is possible for the surgeon or his deputy to supervise the plastered limb and to give it his personal attention should the swelling occur and require relief. Thus the stability of the plaster cast is not destroyed and the position of the bones is not disturbed, but in the present crisis such close supervision is not always possible. Attempts made by inexperienced staff are likely to be disastrous to the stability of the cast and

to the position of the bones. In order to overcome this difficulty and to provide my hard working staff with a plaster cast which they can deal with confidence in my absence, I have for some time now used the following type of cast for such difficult cases.

After surgical toilet and manipulation of the bones into position, the usual posterior slab is applied and gently and evenly moulded on with a broad wet bandage. This posterior slab should encircle two-thirds of the limb. Next an anterior slab is applied to cover half the circumference of the limb and is bandaged in position with a wet bandage. The limb is now elevated as usual with any swollen limb. Should it later become necessary to release pressure on account of the swelling having increased greatly, all that is now required is for a nurse or an orderly to cut through the two layers of ordinary bandage holding the two slabs in place, and the pressure will be at once released evenly throughout the whole length of the limb under plaster. The slabs are maintained in position by tying two or three loops of bandages over them at equal distances along the limb. The slabs adhere sufficiently to the calico bandages to prevent them falling apart when the bandages are cut, and in any case the posterior slab covers two-thirds of the limb and will not fall off if the limb has swollen up. As the swelling goes down all that is required for some time to maintain even firm immobilization is to tighten the two or three loops of bandage holding the slabs in position. The slabs may be thus kept in position for about four weeks. About this time it is better to carefully replaster the limb for the remainder of the time that immobilization will be required.

#### (D) A SIMPLE METHOD OF SETTING AND PLASTERING UNCOMPLICATED ANKLE FRACTURES

All three degrees of abduction-external rotation fracture and fracture dislocation of the ankle joint, i.e.: Pott-Dupuytren types, and all three degrees of abduction fracture and fracture dislocation of the ankle joint can be treated by this simple method. It is not recommended that the method be used for the vertical compression fracture dislocation of the ankle joint where there is so often an anterior marginal fracture of the tibia with forward displacement of the astragalus.

Anæsthesia having been produced by injecting 1 per cent novocain—5 or 10 c.c.—into the sites of fracture, skiagrams are taken in two planes. By the time that the plates have been developed, the anæsthesia will be complete. The patient is assisted to kneel on a chair with his knees well separated, and facing the back of the chair. In this position both the feet will hang free over the edge of the seat of the chair. He is instructed to let both feet hang loose. The fractured ankle will now take up very nearly its normal relations by virtue of its own weight and

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## TREATMENT OF CARBUNCLE WITH EXCISION

By S. P. WANCHOO, M.B. (Punj.), M.R.C.S. (Eng.),  
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THOUGH most experienced surgeons operate on carbuncles in this way, I thought of writing this article, based on records of my cases this summer, purely for the benefit of the general practitioner and the beginner in surgery, who is apt to be lead away by the textbooks, most of which still advocate crucial incision and removal of flaps.

This line of treatment, besides being irrational, does not give good results, as the growing margin of the carbuncle remains untouched.

A carbuncle is infective gangrene of the subcutaneous tissues. Just as in the case of gangrene of a limb, the line of treatment is to amputate through the healthy tissues, so in the case of this type of gangrene, the line of incision should be through the healthy area. Hence the practice of incising into the gangrenous area, as in the case of the crucial incision of the textbooks, appears most unscientific, for there is danger of introduction of sepsis into the systemic circulation.

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the anæsthesia induced. The correctness of the position of the injured foot can easily be checked by reference to normal alongside of it. Any minor correction that may be necessary can then be easily and gently made and maintained by movements directed to the toes and/or the heel. Sometimes it is necessary to wait a few minutes for the injured foot to relax and for the damaged part to fall into place. It is always well worth while to wait patiently for this to happen and for the correction to attain the maximum of its own accord before undertaking any manipulation, for such an exercise of patience is usually well rewarded and any tendency to undue speed and rough handling is avoided.

With the position corrected there is only the posterior slab to be applied. This should be broad enough to cover two-thirds of the circumference of the limb from the toes up to the bend of the knee. In the position in which the patient is on the chair it is an easy matter to apply the posterior slab, mould it carefully, and allow it to dry with the foot in very good position. Once dry the post-reduction skiagrams can be taken to confirm the correctness of the position. The plaster may be completed then either by the rubber tube method, or by the anterior slab method, whichever may be the more applicable to the condition of the limb.

The method is simple and accurate, and is capable of application by even a novice in the art of fracture treatment. It is most gentle and removes any excuse for the use of force in the manipulation of these fractures.

There seems to be a prevailing idea, not only amongst the lay people, but also amongst some medical practitioners, that operative removal should not be carried out in the old, diabetic and/or debilitated patients, because they are not likely to stand the operation. This is contrary to the general principles of surgery and has not been borne out by practical experience. Whereas a young healthy man is likely to recover from a carbuncle even if it is not excised, because of his good general power of resistance in combating septic absorption, this is not the case in the old, diabetic and debilitated individuals. In such persons, the disease is likely to spread more rapidly with the resultant severe toxic symptoms and even fatal results, if the focus of infection is not eradicated early.

Thus early excision is the only rational treatment of carbuncle and is even more important in debilitated individuals. This method not only reduces the mortality rate but also shortens the period of sickness, thereby preventing much unnecessary suffering and pain. This point is clearly brought out from the appended summary of records of my cases treated during this summer. It will be seen that, whereas an average sized carbuncle after operation heals up perfectly in about 6 weeks' time, a case without operation takes much longer.

It will also be noted that out of 9 patients, two refused operation. Out of the latter one died and the other took 3 months to recover.

From the point of view of treatment the carbuncle may be divided into two stages :

*1st stage.*—A hard painful swelling in the subcutaneous tissues, often on the back, the skin over which becomes dusky and oedematous.

*2nd stage.*—Swelling still more prominent, the skin over the area becomes purplish and usually ulcerates in several spots near the centre, exposing to view the ashy slough of the subcutaneous tissue, allowing exit to thin sero-pus.

An average Indian patient, who is apt first to resort to the homely remedies, usually comes to the doctor in the second stage of the disease. This really should not matter as the line of treatment in the first stage consists of applying fomentations to relieve pain and promote hyperæmia, and this is what most of the homely remedies, whether in the form of a poultice, a hot water-bottle, etc., aim at.

The only rational treatment in the second stage consists of excision, as soon as possible.

*Choice of anæsthesia.*—If the patient is young and his urine does not contain sugar and albumin, gas and ether are the best. If general anæsthesia is contraindicated on account of diabetes, nephritis or old age, then local anæsthesia is used. The exact procedure I follow is as under :—

Morphia  $\frac{1}{4}$  gr. is given about forty-five minutes before the operation. Infiltration of the healthy tissues is done all round with 1 per cent novocain or 1 in 1,000 percain with a Lobat's syringe. This type of syringe with its lock for

TABLE

Summary of case records of carbuncle cases treated in Alexandra Hospital, during summer 1942

| Case number | Age | Date of admission | Summary of clinical notes  | Urine report                                 | Treatment   | Date of discharge from hospital | Condition on discharge   | Date of final cure | Total number of days in treatment | Result |
|-------------|-----|-------------------|--|--|---|---------------------------------|--|--------------------|-----------------------------------|--------|
| 1           | 50  | 14-6-42           | Carbuncle on the back 4" X 4" on the surface, duration one month.  | Albumin present, a trace. Nil else abnormal. | Patient refused operation, was put on infra-red ray exposures.  | 12-8-42                         | On discharge had an ulcer 2" X 2".   | 10-9-42            | 86                                | Cured. |
| 2           | 80  | 26-6-42           | Carbuncle on the back 5" X 5" on the surface, duration 2 months.   | Normal                                       | Excision under local anaesthesia.   | 28-7-42                         | Clean granulating wound.   | 10-8-42            | 45                                | Cured. |
| 3           | 33  | 26-6-42           | Carbuncle on the back 4" X 4" on the surface, duration 7 days.   | A trace of albumin. Nil else abnormal.       | Excision under general anaesthesia on 7-7-42 as he refused operation earlier.                                       | 19-8-42                         | Wound completely healed.   | 19-8-42            | 55                                | Cured. |
| 4           | 72  | 28-6-42           | Carbuncle on the back 5" X 5", duration 15 days. Developed rashes of acute pemphigus all over the body on 18-7-42. Became intensely toxic. Developed fainting attacks which became more and more frequent.           | Normal                                       | Refused operation. Was put on infra-red exposures and sulphathiazole internally.                                    | 29-7-42                         | Died   | ..                 | ..                                | Died.  |
| 5           | 59  | 30-6-42           | Carbuncle on the back 4" X 4", duration 12 days. Also had an abscess in the finger, duration 25 days. Other abscesses developed in the body later on. Also developed dry gangrene of the terminal phalanx of finger. | Sugar present 5 per cent.                    | Carbuncle excised and abscess in finger incised. Terminal phalanx of finger amputated; other abscesses were opened. | 9-9-42                          | All wounds healed.   | 9-9-42             | 69                                | Cured. |
| 6           | 50  | 8-7-42            | Carbuncle on the back 4" X 4" on the surface, duration 7 days.   | A trace of albumin. Nil else abnormal.       | Excision under local anaesthesia.   | 8-8-42                          | Wound healed except for an area $\frac{1}{2}$ " square, and was covered up with elastoplast. | 18-8-42            | 40                                | Cured. |
| 7           | 50  | 9-7-42            | Carbuncle on the back 4" X 4", duration 8 days.  | Normal                                       | Excised under general anaesthesia. Infra-red rays during convalescence.   | 13-7-42                         | On discharge had an ulcer 4" X 4".   | 9-8-42             | 30                                | Cured. |

TABLE—*concl'd.*

| Case number | Age | Date of admission | Summary of clinical notes   | Urine report                    | Treatment  | Date of discharge from hospital | Condition on discharge   | Date of final cure | Total number of days in treatment | Result |
|-------------|-----|-------------------|---|---------------------------------|--|---------------------------------|--------------------------|--------------------|-----------------------------------|--------|
| 8           | 45  | 12-7-42           | Carbuncle on the back of neck 4" × 4", duration 7 days.                                     | Sugar a trace, albumin a trace. | Excised under local anæsthesia.  | 29-7-42                         | Wound 3" × 3".           | 21-8-42            | 40                                | Cured. |
| 9           | 65  | 30-7-42           | Carbuncle on the back 6" × 6" on the surface, duration 20 days. Deep muscles were involved. | Sugar a trace, albumin a trace. | Excision under local anæsthesia on 31-7-42. Involved muscles also excised. Thiersch grafting on 19-8-42. | 9-9-42                          | Wound completely healed. | 9-9-42             | 40                                | Cured. |

the needle is almost indispensable for such work, especially as the tissues are very hard, and proper infiltration with an ordinary syringe is very difficult. Soon after finishing the local infiltration, further morphia  $\frac{1}{2}$  gr. is given. After 10 minutes the operation is started and except in very hyperæsthetic persons, there is no trouble during the course of the operation.

**Operation.**—The growing margin of the carbuncle is first felt all round, and the incision is made just outside. The cut skin along with the carbuncle on one side is caught in Lane's tissue forceps and the carbuncle is dissected out like a tumour. If by any chance the knife cuts into the carbuncle itself, then one must go deeper or wider and excise the whole thing *en bloc*. Most of the hæmorrhage stops with hot sponges but if any vessel still bleeds, it is ligated. The wound is dressed with concentrated solution of magnesium sulphate in glycerine for 3 or 4 days and later with B.I.P.P. or mercurochrome (or acriflavine) in liquid paraffin.

**Convalescence.**—After having been sleepless for so many days, the patient has a very restful night following the operation and the next morning one finds that the wound is clean and quite healthy. In 10 or 15 days the wound becomes smaller and is covered up with healthy granulations and all one has to do is to apply a strip of stretched elastoplast, to enable the wound to heal undisturbed under it.

If the area is very big, skin grafting may have to be done (as in case 9 of my series). The diabetics are given a carefully planned nutritious diet with adequate units of insulin, the diet being controlled by daily urine examinations.

Other cases including the old and debilitated are given liberal diet. Tonics are very useful. The convalescence is usually uneventful except in diabetics who may develop abscesses on other parts of the body. These abscesses are opened as and when they occur.

## SURVIVAL OF *VIBRIO CHOLERÆ* IN GASTRIC JUICE

By L. EVERARD NAPIER, C.I.E., F.R.C.P. (Lond.)  
and

S. K. GUPTA, M.B., D.T.M.  
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**Introduction.**—In a paper on the gastric acidity in cholera convalescents Pasricha and others (1940) found that 36 per cent of cases had achlorhydria, 52 per cent a low acid content, and 12 per cent a normal curve; none had hyperchlorhydria or even a high normal curve. They made three suggestions for the cause of this low acidity in their series, namely (a) that it might be the result of acute gastritis and quoted Sir Arthur Hurst's well-known views on this subject, or (b) that the loss of water, acid, and chlorides might have caused a depletion from which the patient had hardly recovered. Neither of these explanations for the low acid curve in these cases seems to us to be very probable, for (a) the 'gastritis' of cholera is scarcely comparable to the chronic gastritis to which Sir Arthur Hurst refers, and even then many people do not accept his views on this subject, and (b) the bio-chemical balance of the cholera patient would usually have been re-established by the time the samples were taken in this investigation.

The third explanation, not of the low acid curve in these particular patients but of the writers' findings, seems to us to be a much more probable one, namely (c) that persons with a low acid curve were more liable to get cholera and that therefore these writers' clinical material had been subjected to a degree of natural selection.

We decided to carry out a very simple investigation to test further the probability of this last explanation.

**Experimental.**—We took the gastric juice from a number of patients in hospital, in whom



gastric analysis was being done in the routine investigation of the condition from which they were suffering. A definite amount of fresh cholera culture was added to each tube containing gastric juice and after different intervals the gastric juice was plated to see whether the vibrios were alive or not.

The fasting juice and several other samples were taken in sterile test-tubes in measured quantities and a 24-hours' broth culture of 'smooth' *Vibrio cholerae* was added to the tubes so that the culture added amounted to one-fifth of the volume of gastric juice present in the tubes. The tubes were then thoroughly shaken and plated on 0.5 per cent bile-salt agar; subsequently they were again shaken and plated after intervals of 15 minutes, half an hour, 1 hour, 2 hours, 3 hours, 24 hours, 48 hours, 72 hours, and so on until the vibrio colonies failed to appear. This procedure was carried out with the gastric analysis samples of 10 patients.

*Free acid.*—The full results in two cases, one a case of hyperchlorhydria and the other a case hypochlorhydria, are given in detail in tabular form below (tables I and II). The contrast is most striking. It will be seen that, in the hyperchlorhydric case, the vibrios

the rest survived for various period, from 96 to 370 hours.

Thus, as far as free acid is concerned, it is apparent that the vibrios survive for a very long time in the absence of acid, that if any acid at all is present they survive for only a short period, and that, if there is more than the equivalent of 22 c.cm. of N/10 HCl in 100 c.cm. of gastric juice, they are always killed immediately.

*Total acid.*—From table II there is a suggestion that in the absence of free acid the combined acid has some influence on vibrio survival; for example, in the fasting juice and in sample 8, the total acid is 16 degrees, and the maximum survival is 24 hours, whereas in samples 3 and 4 when the total acid is 10 and 8, the vibrios survived for 264 and 192 hours, respectively.

The same suggestion is conveyed by table III, in which, while in cases 1 and 7, the 'total' acid is 16 and 18, respectively, the survival period is 24 hours and nil, whereas in the other samples with less 'total' acid the mean survival rate is just about 200 hours. The data on this point are, however, not sufficient to warrant any conclusions.

*Discussion.*—Panja and his co-workers (1942) showed that vibrios are only found in

TABLE I

*Effect of different samples of gastric juice on cholera vibrio cultures in a case of hyperchlorhydria*

| Gastric juice ..  | 1.4 c.cm.                           | 1.3 c.cm.                           | 1.3 c.cm.                           | 1.6 c.cm.                           | 1.2 c.cm.                            | 2.3 c.cm.                            |
|---|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|
| 24-hour broth culture of vibrio.  | 0.28 c.cm.                          | 0.26 c.cm.                          | 0.26 c.cm.                          | 0.32 c.cm.                          | 0.24 c.cm.                           | 0.46 c.cm.                           |
| Sample ..   | Fasting                             | No. 1                               | No. 2                               | No. 3                               | No. 4                                | No. 5                                |
| Time of plating after the addition of cholera vibrio to the gastric juice | Free acid<br>32<br>Total acid<br>44 | Free acid<br>26<br>Total acid<br>40 | Free acid<br>50<br>Total acid<br>64 | Free acid<br>78<br>Total acid<br>90 | Free acid<br>90<br>Total acid<br>102 | Free acid<br>94<br>Total acid<br>108 |
| Stat.<br>1 hour   | ..                                  | ..                                  | ..                                  | ..                                  | ..                                   | ..                                   |
| 2 hours   | B+                                  | B+                                  | B+                                  | ..                                  | ..                                   | ..                                   |
| 4 "   | ..                                  | B+                                  | ..                                  | ..                                  | ..                                   | ..                                   |
| 24 "  | ..                                  | ..                                  | ..                                  | ..                                  | ..                                   | ..                                   |

were killed immediately in every sample, whereas in the other case they survived up to 24 hours in 8 out of 10 samples, and in one sample up to 264 hours.

Table III is a summary of the findings in all the ten cases. It will be observed that in every case the vibrio was killed immediately if the free acid was over 25 degrees of acidity\*, and, even over 5 degrees, they did not survive for more than one hour. On the other hand, in the absence of any acid at all, only one out of 13 was killed immediately, 3 within 24 hours, and

\*The degrees of acidity being the amount in c.cm. of N/10 NaOH that are required to neutralize 100 c.cm. of gastric juice.

the vomitus when this is alkaline in reaction. Unfortunately these workers estimated the hydrogen-ion concentration only, whereas we estimated the neutralizing value of the gastric juice. These two values are not capable of conversion one into the other, but they are naturally closely correlated. We have been able to show that in the absence of any free acid the pH is usually between 8.0 and 6.0 and that in the presence of an acidity of 22 degrees, the pH is never above 4.75. The two sets of findings are therefore strictly compatible; Panja and his co-workers never found vibrios in the vomitus if the pH was 4.9 or less, whereas, if it was above this but less than 7.0, vibrios were present

TABLE II  
Effect of different samples of gastric juice on cholera vibrio cultures in a case of hypochlorhydria

[illegible]

in half the samples, and, when the pH was above 7.0, vibrios were found in 12 out of 14 samples.

*Dilution of gastric juice.*—It is obvious that *in vivo* there would be some dilution of the gastric juice if water were taken. In order to see how this would affect the destruction of the vibrios by the hydrochloric acid, we diluted

gastric juice with sterile distilled water before adding it to the vibrio emulsion. The results are shown in table IV. —

**Discussion.**—As one would expect dilution has a marked effect in prolonging the time of survival of the vibrios. The fact that a one-in-five dilution, when the acidity was 30 units or

TABLE III

Chart showing life of cholera vibrios in hours in gastric juice of different ranges of free and total acidity, in 10 cases.

| Free acid  | 0   |     |     |     |     |    |    | Up to 5       |    |               |               | 6 to 10 |    |    | 11 to 15 |    |    |               |               | 16 to 20      |    |
|------------|-----|-----|-----|-----|-----|----|----|---------------|----|---------------|---------------|---------|----|----|----------|----|----|---------------|---------------|---------------|----|
| Total acid | 0   | 8   | 10  | 12  | 14  | 16 | 18 | 12            | 14 | 16            | 18            | 18      | 22 | 24 | 20       | 22 | 24 | 28            | 30            | 32            | 36 |
| Case 1 ..  | ..  | 144 | 264 | 96  | ..  | 24 | .. | ..            | .. | ..            | ..            | ..      | .. | S  | ..       | .. | .. | ..            | ..            | ..            | .. |
| Case 2 ..  | ..  | ..  | ..  | ..  | ..  | .. | .. | ..            | .. | ..            | ..            | ..      | .. | .. | ..       | .. | .. | ..            | ..            | ..            | .. |
| Case 3 ..  | ..  | ..  | ..  | ..  | ..  | .. | .. | ..            | .. | ..            | ..            | ..      | .. | .. | ..       | .. | .. | ..            | ..            | ..            | .. |
| Case 4 ..  | 264 | ..  | ..  | 264 | ..  | .. | .. | ..            | S  | ..            | ..            | ..      | .. | .. | ..       | .. | .. | ..            | ..            | 0             | S  |
| Case 5 ..  | ..  | ..  | ..  | 194 | ..  | .. | .. | 194           | .. | ..            | ..            | ..      | 1  | .. | ..       | .. | .. | ..            | ..            | ..            | .. |
| Case 6 ..  | ..  | 24  | 312 | 24  | 144 | .. | .. | ..            | .. | $\frac{1}{2}$ | ..            | ..      | .. | .. | 0        | .. | .. | ..            | ..            | ..            | .. |
| Case 7 ..  | ..  | ..  | ..  | 356 | 370 | .. | 0  | ..            | .. | ..            | ..            | ..      | .. | .. | ..       | .. | .. | ..            | ..            | S             | .. |
| Case 8 ..  | ..  | ..  | ..  | ..  | ..  | .. | .. | ..            | .. | ..            | $\frac{1}{2}$ | ..      | .. | .. | ..       | .. | .. | $\frac{1}{2}$ | $\frac{1}{2}$ | ..            | .. |
| Case 9 ..  | ..  | ..  | ..  | ..  | ..  | .. | .. | ..            | .. | ..            | ..            | S       | .. | .. | ..       | 0  | 0  | ..            | ..            | $\frac{1}{2}$ | .. |
| Case 10 .. | ..  | ..  | ..  | ..  | ..  | .. | .. | $\frac{1}{2}$ | .. | S             | ..            | 0       | .. | .. | S        | .. | .. | ..            | ..            | ..            | .. |

TABLE III—concl'd.

| Free acid  | 21 to 25      |    |    | 26 to 30 |    | 31 to 35 | 36 to 40 |          | 41 to 45 |    | 46 to 50 |    |    | 51 to 55 |    | 56 to 60 | 61 to 65 | 66 to 70 | 71 to 75 | 76 to 80 | 80 to 90 | 90 to 95 |
|------------|---------------|----|----|----------|----|----------|----------|----------|----------|----|----------|----|----|----------|----|----------|----------|----------|----------|----------|----------|----------|
| Total acid | 32            | 36 | 38 | 40       | 44 | 40<br>44 | 50       | 52<br>56 | 54       | 56 | 55       | 56 | 60 | 62       | 64 | 72       | 70       | 78       | 92       | 90       | 102      | 108      |
| Case 1..   | ..            | .. | .. | ..       | .. | ..       | ..       | ..       | ..       | .. | ..       | .. | .. | ..       | .. | ..       | ..       | ..       | ..       | ..       | ..       | ..       |
| Case 2..   | ..            | .. | .. | 0        | .. | 0        | ..       | ..       | ..       | .. | ..       | .. | 0  | ..       | .. | ..       | ..       | ..       | ..       | 0        | 0        | 0        |
| Case 3..   | $\frac{1}{2}$ | 0  | .. | 0        | 0  | 0        | ..       | ..       | ..       | 0  | ..       | .. | .. | ..       | .. | 0        | ..       | 0        | ..       | ..       | ..       | ..       |
| Case 4..   | ..            | 0  | .. | ..       | 0  | ..       | ..       | 0        | ..       | .. | ..       | .. | .. | ..       | .. | ..       | ..       | ..       | ..       | ..       | ..       | ..       |
| Case 5..   | ..            | .. | .. | ..       | .. | ..       | ..       | ..       | ..       | .. | ..       | .. | .. | ..       | .. | ..       | ..       | ..       | ..       | ..       | ..       | ..       |
| Case 6..   | ..            | .. | 0  | ..       | 0  | 0        | ..       | ..       | ..       | .. | ..       | .. | .. | ..       | .. | ..       | ..       | ..       | ..       | ..       | ..       | ..       |
| Case 7..   | ..            | 0  | .. | ..       | .. | ..       | ..       | ..       | ..       | .. | ..       | .. | .. | ..       | .. | ..       | ..       | ..       | ..       | ..       | ..       | ..       |
| Case 8..   | ..            | .. | .. | ..       | .. | ..       | ..       | ..       | ..       | .. | ..       | .. | .. | 0        | .. | ..       | 0        | ..       | 0        | ..       | ..       | ..       |
| Case 9..   | ..            | .. | .. | ..       | 0  | ..       | 0        | 0        | 0        | .. | 0        | .. | .. | ..       | .. | ..       | ..       | ..       | ..       | ..       | ..       | ..       |
| Case 10..  | ..            | .. | .. | ..       | .. | 0        | 0        | ..       | 0        | .. | ..       | 0  | .. | ..       | 0  | ..       | ..       | ..       | ..       | ..       | ..       | ..       |

The figures in the chart indicate the number of hours of survival of *Cholera vibrio* after they have been added to the different samples of gastric juice. 0 indicates killed immediately, that is to say, there was no growth even after first plating. S indicates that the vibrios were alive at the time they were plated.

less, allowed the vibrios to survive almost indefinitely is more or less in keeping with our previous observations, and suggest that it is mainly the acidity *per se* that kills them.

This indicates that when water is the medium of infection and a large draught is taken, the vibrio will pass through the stomach in a viable form, despite a high acidity.

**Conclusions.**—Cholera vibrios are killed very rapidly when they come in contact with gastric juice with an acidity of 22 degrees or more, and in the presence of any free acid they do not survive long. In the absence of acid they may survive up to 15 days. Whilst admittedly the gastric juice is subjected to considerable dilution *in vivo*, the presence of even small amounts of

TABLE IV  
*Life of cholera vibrios in diluted gastric juice*

| Number of sample of gastric juice | Free acid | Total acid | LIFE OF CHOLERA VIBRIOS IN HOURS IN THE FOLLOWING DILUTION OF GASTRIC JUICE |         |         |         |
|-----------------------------------|-----------|------------|---|---------|---------|---------|
|                                   |           |            | 1 in 5  | 1 in 10 | 1 in 15 | 1 in 20 |
| Case                              |           |            |   |         |         |         |
| 2                                 | 0         | 8          | 500*  | 500*    | 500*    | 500*    |
| 5                                 | 18        | 28         | 4   | 310     | 500*    | 500*    |
| 8                                 | 38        | 50         | 1/4   | 500*    | 500*    | 500*    |
| 9                                 | 40        | 52         | 1/4   | 500*    | 500*    | ..      |
| Case                              |           |            |   |         |         |         |
| 2                                 | 70        | 20         | 624*  | 624*    | 624*    | ..      |
| 5                                 | 34        | 46         | 0   | 624*    | 624*    | 624*    |
| 7                                 | 30        | 42         | 42  | 42      | 624*    | 624*    |
| 9                                 | 12        | 24         | 624*  | 624*    | 624*    | 624*    |

\* Experiment terminated at 500 or 624 hours.

free hydrochloric acid is so fatal to the vibrio that it seems justifiable to conclude that the individual with a low-acid gastric juice may be much more susceptible to cholera infection than the individual with a normal or high acid content.

This seems to add support to the third reason put forward by Pasricha and his co-workers (*loc. cit.*) to explain their findings of a low gastric acidity in cholera convalescents.

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*VITEX PEDUNCULARIS*—AN ANTIHÆMOLYTIC AGENT

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*Résumé of previous work.*—Vaughan (1921) found that an aqueous infusion of the leaves of *Vitex peduncularis*, Wall, var. *roxburghiana*, was being used by the aboriginal tribe of Ranchi in malaria and blackwater fever. Though the medicinal properties of the members of the Vitex family (e.g. *Vitex trifolia*, *negundo*, etc.) have been elaborately described in the Ayurvedic system of medicine, the *Vitex peduncularis* Wall, var. *roxburghiana*, had not been mentioned by the early Hindu pharmacists. Vaughan (1921) used an infusion of the fresh leaves of the plant in the treatment of malaria. Four cases of

blackwater fever were also treated 'with success'. He concludes thus—

'In vitex it may be that we shall find active principles which will give us all the power of quinine in malaria without many of the dangers and drawbacks of quinine and its allied alkaloids.'

Chopra, Knowles, and Gupta (1924) gave the drug a fair trial in malaria in the Carmichael Hospital for Tropical Diseases. They reported that 'the drug appeared to be absolutely useless in the treatment of malaria'. Measham (1940) treated eleven cases of blackwater fever with the vitex infusion (prepared according to Vaughan) 1 ounce hourly until the colour of the urine returned to normal. Some of his cases had malaria parasites in the blood: in a few cases atebirin or quinine in doses too small to influence the course of the disease was used. He found that all except one improved considerably in three days: urine cleared on the third day after vitex and the temperature came to normal within three days. He concluded that 'vitex had definite value in the treatment of blackwater fever'. Commenting editorially on this paper, Dr. L. Everard Napier wrote:—

'... it is obvious that *Vitex peduncularis* is at best a poor antimalarial drug, and we have good antimalarial drugs at our disposal.

If it is not on account of its antimalarial properties, how then does it act? In an attack of blackwater fever there is often one severe hæmolytic crisis in which all the damage is done; in such a case treatment consists in helping the body to tide over the shock, to recover its normal functions and repair the damage. Whilst it is conceivable that there are many drugs that will assist this, there does not seem room here for a 'specific'.

On the other hand, it is conceivable that there might be some specific drug that would prevent further hæmolysis, and would, therefore, if used prophylactically, prevent the initial attack. Is *Vitex peduncularis* such a drug? There is no evidence that it has such an action or for that matter that it has any action at all. The clinical trials reported are not very convincing; to be so, they will have to be carried out on a much larger scale. Statistically there is no significant difference between a 10 per cent and a 20 per cent, 30 per cent, 40 per cent, or even 50 per cent death rate,

when the total number of subjects in each series is only 10, and clinical progress is so much a matter of personal opinion subject to all kinds of influences, that it is liable not to carry much weight outside the clinician's personal sphere.

Whether or not a *prima facie* case has been made out to justify pharmacological investigations . . . it is for the pharmacologists to decide'.

Since this date Roy (1941) has reported a further ten cases of blackwater fever treated with *Vitex peduncularis* with one death only. He used two preparations of vitex, one for intramuscular injection and the other a tincture for oral administration. The patients received an initial intramuscular injection of 2 to 3 c.cm. of the injectable preparation followed by the tincture in 10 to 15 min. doses thrice daily. Depending on the severity of the case the injection was repeated the same day or for the next 2 or 3 days. The oral administration was continued for 3 or 4 days after the cessation of hæmoglobinuria.

This brief résumé of the work done with *Vitex peduncularis* shows that the clinical approach for elucidating the action and use of vitex has not provided any clear cut evidence as to its uselessness. We, therefore, thought that it was worth while taking up Dr. Napier's suggestion that the next move should come from the pharmacologist, and we decided to undertake certain experiments, choosing first the investigation of the anti-hæmolytic properties of this plant.

### Experimental work

We undertook work under three headings :—

#### I. *In vitro* experiments.

#### II. *In vivo* experiments.

#### III. Physical effect on blood and red cells.

It is proposed to publish full details of the technique at a later date when the investigations are complete; meanwhile, however, a summary of the results of our preliminary observations is given.

#### I. *In vitro* experiments

1. *Fragility (or osmotic resistance) of rabbit red cells.*—Average osmotic resistance of the washed rabbit red cells was found to be 0.75 per cent saline. The addition of vitex in the proportion of 1 drop per 10 c.cm. increased the osmotic resistance of the rabbit red cells. 0.65 per cent saline which hæmolyzed the normal washed cells almost immediately, could not hæmolyze the vitex-treated cell even in 1 hour.

2. *Saponin hæmolysis.*—Crude saponin 1 in 26,000 (approximately) in normal saline (0.85 per cent) hæmolyzed the washed red blood cells of the rabbit (in half an hour); 1 drop of vitex per 10 c.cm. prevented the saponin hæmolysis.

3. *Bile salt hæmolysis.*—The washed red blood cells of the rabbit were completely hæmolyzed by bile salt (sodium taurocholate was used) in a concentration of 0.5 mg. in 10 c.cm. (i.e. 1 in 20,000) of 0.85 per cent of normal saline. Addition of 1 drop of vitex per 10 c.cm. of the hæmolytic solution entirely prevented hæmolysis.

4. *Cobra venom hæmolysis.*—Vitex proved to be an efficient anti-hæmolytic agent to the hæmolysin of the cobra venom (1 drop of 1 in 500 in 10 c.cm. of 0.85 per cent saline).

5. *Acid hæmolysis.*—Addition of 1 drop of vitex per 10 c.cm. was found to resist the hæmolysis caused by

inorganic acid (1 in 1,000 of hydrochloric acid in normal saline).

#### II. *In vivo* experiments

(a) Osmotic resistance of the hare red blood cells was increased after vitex given intramuscularly. The effect attained its maximum after about two hours; then gradually diminished; by the fourth hour the red cells had reverted almost to the pre-injection condition of resistance. In one animal the osmotic resistance was estimated 24 hours after the injection; no effect persisted. Very little or no effect was observed within an hour of injection.

*Acid and saponin hæmolysis.*—Injection of vitex intramuscularly in the hare increased the resistance of the red cells against hæmolysis by both these agents.

#### Effect after oral administration

Osmotic resistance of the hare red blood cells was slightly increased after oral administration. The effect, more evident with the higher dose (1 c.cm.), was maximum after 2 hours and disappeared by the fourth hour.

#### III. Physical effect on blood and red cells

The red cell charge, packed volume of the red cells and the viscosity of the blood before and after vitex have been studied in some instances. The preliminary results strongly suggest that the action of vitex is directly on the red cells, very likely on the surface of the cells.

*Discussion.*—There now seems to be a *prima facie* case for testing the antihæmolytic property of vitex in those pathological conditions characterized by increased disintegration of the red cells. The mechanism of hæmolysis in blackwater fever has not yet been established beyond doubt, but it may be assumed that in blackwater fever, as in malaria, the red cells are less resistant to lysis (but not always to hypotonic saline). Vitex will probably make the red blood cell more lysis-resistant. It is an observed fact that in blackwater fever the hæmolytic crisis occurs suddenly without any premonitory sign and hence vitex cannot be used to cure the resultant hæmoglobinæmia with its associated symptoms, but if it were possible to use vitex prophylactically it seems possible that it would prevent the blackwater fever. It is true that we have no means of knowing beforehand those cases of fever which will develop into blackwater fever, but there is ample reason to believe that *Plasmodium falciparum* (malignant tertian) infection, if treated irregularly with quinine in endemic areas, often develops into blackwater fever. It is undoubtedly true that in many cases the use of quinine precipitates an attack of blackwater fever. We believe that the use of vitex in these cases in a prophylactic manner, before giving quinine, is justifiable. It has also been observed that, after the hæmolytic crisis the osmotic resistance of the remaining red cells is higher (Ott, 1932). This is due to the escape of the normally more resistant cells from hæmolysis. But the new cells that are being added to the circulation will have a population with the usual proportion of less resistant cells. The previously more resistant cells are also becoming less

(Concluded on opposite page)

# SEARCH FOR AN ANTIMALARIAL DRUG IN THE INDIGENOUS MATERIA MEDICA

PART I—*Alstonia scholaris*, F. Br.

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## Introduction

THE possible shortage of quinine, which has remained the mainstay of the physicians in the treatment of malaria for nearly three centuries

(Continued from previous page)

resistant. *Vitex* will possibly inhibit hæmolysis of the more vulnerable cells and will thus prevent relapse of the hæmolytic crisis, diminish the increased disintegration of red cells which is usual in this disease, and thus improve the condition of the blood.

## Conclusion

We are now in a position to answer the question quoted above—'It is conceivable that there might be some specific drug that would prevent further hæmolysis and would, therefore, if used prophylactically, prevent the initial attack. Is *Vitex peduncularis* such a drug?' The plant appears to contain some substance or substances with these properties.

It would be unwise from the data given here to draw definite conclusions regarding the value of *Vitex peduncularis* in the prophylaxis or treatment of blackwater fever. So far we have studied only its action on the red cells of healthy animals. Similar work is now being attempted in man in health and disease.

## Summary

1. *Vitex peduncularis* increases the osmotic resistance of the red blood cells of animals.
2. It inhibits hæmolysis by saponin, acid, cobra venom and bile salts.
3. It is absorbed when given intramuscularly, the maximum effect being attained within two hours; the injection is apparently without any toxic effect.
4. Absorption through the alimentary tract may take place but the rate is extremely slow and depends on the size of the dose.
5. It is assumed that the action is on the red blood cell surface.

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since the discovery of cinchona bark, has naturally stimulated new interest in the search for substitutes which can be used with the same degree of efficiency as quinine. In view of the already established antimalarial value of synthetic derivatives, e.g., Atebrin (Mepacrine Hydrochloride, B. P. Addendum, 1940) and Plasmochin (Pamaquin, B. P. Addendum, 1940), attempts have been made in India to synthesize these products and it is reported that a certain amount of success has already been achieved in this direction. The limitation of synthetic antimalarials, as far as production in India is concerned, is obvious, in that quite a large number of basic and intermediate chemicals necessary for synthesis have to be imported from foreign countries. It seemed worth while, therefore, to explore, by modern scientific methods of investigation, the possibilities of finding a substitute, if possible, from the indigenous materia medica. A number of natural drugs have enjoyed a local reputation as febrifuges and antimalarial remedies for a long time. The present paper deals with one member of this group, *Alstonia scholaris* (N. O. Apocynaceæ), the vernacular (Hindi and Bengali) synonym of which is 'chhatim'.

## General description, chemistry, pharmacology, etc.

*Alstonia scholaris* is a tall evergreen tree widely cultivated throughout India and found in the sub-Himalayan tract from the Jumna eastward ascending to 3,000 feet. The tree is also found in abundance in Bengal. The bark of the tree has been reputed in the Hindu medicine for ages as a febrifuge, alterative, tonic and gastro-intestinal sedative. There is hardly an Ayurvedic prescription for acute and chronic fever or diarrhoea where 'chhatim', in some form or other, is not used. It was also recognized in the B. P. 1914.

An uncrystallizable bitter principle called 'ditain' was isolated and the febrifugal properties of the drug were ascribed to this principle by earlier workers. Later investigations showed that the following constituents were probably present: (1) an alkaloid, ditamine, (2) a substance resembling an alkaloid, (3) a crystallizable acid and (4) a fatty acid and resinous substances. Bacon (1906) found the presence of two alkaloids, 'ditamine' and 'echitamine'. Goodson and Henry (1925) reported that the principal alkaloidal constituent of *A. scholaris* and other allied species such as *A. congesta*, *A. gillettii*, *A. angustiloba* and *A. spathulata* was 'echitamine', (C<sub>22</sub>H<sub>28</sub>O<sub>4</sub>N<sub>2</sub>). This alkaloid, however, was found to be absent in other representatives of the Alstonias, e.g., *A. constricta*, *A. macrophylla* or *A. villosa* (Goodson, 1932). Sharp (1934) reported the presence of 4 alkaloids in *A. constricta*, of which 'alstonine' was considered the chief one and was obtained in crystalline form as sulphate.



Bacon (*loc. cit.*) studied the pharmacological action of echitamine on unicellular protoplasm represented by amœbæ. Exposed for 2 hours in a 1 per cent solution, amœbæ were reported to have thrived well and the conclusion was drawn that echitamine would not act as a protoplasmic poison like quinine or emetine. Goodson, Henry and Macfie (1930) tried the alkaloids, 'echitamine', 'ditamine', 'akuammine' and 'harmine', in bird malaria and found them inactive, except 'echitamine' which produced feeble action in doses of 5 mg. per dose. Buttle (mentioned by Sharp, *loc. cit.*) recorded the inactivity of alstonine sulphate in bird malaria.

### Experimental

(a) *Separation of total alkaloids.*—In view of the conflicting and partly inconclusive data with regard to the efficacy of individual alkaloids of the *Alstonias*, it was decided to carry out our investigations first with purified total alkaloids of *A. scholaris* obtained from Bengal and, in the event of positive findings, to follow up the work with various related individual alkaloids which could be isolated in a pure state, by following the detailed method employed by Sharp (*loc. cit.*) in the case of *A. constricta*. The method followed for the extraction of total alkaloids is given below :—

About one and a half kilograms of powdered bark were moistened with rectified spirit and extracted in a percolator for several days until exhausted. The solvent was removed and the black viscous residue was extracted with 0.5 per cent  $H_2SO_4$ . The aqueous extract was filtered from insoluble resinous and fatty matter, diluted with water, allowed to settle and again filtered. The filtrate was shaken out with ether several times in order to remove the soluble impurities. The aqueous layer was then transferred to a second separator, chloroform was added, the solution made alkaline with  $Na_2CO_3$ , and extracted several times with fresh chloroform. It was then made strongly alkaline with 20 per cent NaOH solution and further extracted with chloroform until completely exhausted. The mixed chloroform extract was then evaporated to a small bulk and the total alkaloids were taken up by acidulated water (0.5 per cent  $H_2SO_4$ ). This process was repeated again for purification. Finally, the chloroform extract was evaporated to dryness in a vacuum and neutralized with alcoholic sulphuric acid. The yield was found to be approximately 0.3 per cent of the bark.

(b) *Pharmacological studies.*—A 1-2 per cent solution of the sulphate of the total alkaloids (TAS) was used in these investigations. The important point to find out was whether the toxicity of the total alkaloids would lie within such dose range as to enable it to be used therapeutically without the possibility of any untoward toxic reactions and no attempt was therefore made to work out systematically the minimum lethal dose. It was found that a dose of 20 mg. per kilo. could be well tolerated in the monkey and about 10 mg./kg. in the cat.

Administered intravenously in the anesthetized cat (chloralose or urethane) in a dose of 4-8 mg. per kilo., a slight fall followed by a rise in blood pressure is produced. The fall in blood pressure is not much affected by atropinization. In spinal cat preparations, a distinct but temporary rise of about 10-15 mm. Hg. is noticeable. This points to a predominance of the central effect to the parasympathetic effect of the drug in bringing about the fall of pressure. The muscular effect of TAS may also be important, as will be evident from the fact that an increased tone and contraction is often observed in isolated rabbit or guinea-pig uterus in as low a dose as 1 in 20,000 to 1 in 10,000. Isolated rabbit intestine also gives indications of stimulation in a concentration of 1 in 20,000. Isolated frog heart is

mildly stimulated in 1 in 10,000; in higher concentrations, a depression with measurable diminution of the outflow of the perfusate is observed.

(c) *Chemotherapeutic studies.*—These were carried out on rhesus monkeys (*Silenus rhesus*) weighing between 2.5 to 3.0 kilo. infected with *Plasmodium knowlesi*. The inoculum consisted of 1 c.cm. infective blood given intraperitoneally. Injections of TAS in different dosages were given intramuscularly at various stages of the infection. Regular parasite counts were made once a day and sometimes twice a day. Control experiments were run side by side with quinine administered by the intramuscular route. It was found that TAS failed either to retard or to control the progress of infection. If the injections were made when the infection was fairly advanced (say, about 2,000 parasites per 10,000 red cells), the monkeys died invariably, as would have been the case had no treatment been administered at all. Contrary to the findings of Goodson, Henry and Macfie (*loc. cit.*) with echitamine, even a prolongation of the period of survival (when compared with control animals) could not be noticed. Attempts were made to save the animals by intravenous quinine in the late stages but this was ineffective in most cases. In some of the later experiments, quinine was given earlier when the infection was milder (about 1,000 parasites per 10,000 red cells) and in such instances, it was possible to save the animals or establish a chronic infection. The results of a representative series of experiments are given in the following table on the opposite page.

(d) *Clinical studies.*—It is a popular belief in Bengal and some other parts of India that genuine 'chhatim' (dita bark), if administered in the form of a decoction ('pachan') according to strict Ayurvedic principles, is almost as effective as quinine. In Manila Hospital, the results of trials in malaria cases were reported to be very satisfactory and it was opined that it would completely replace quinine in malignant tertian fevers (Chopra, 1933). The drug was also tried in India in 14 cases of malaria at the instance of the Indigenous Drugs Committee; Madras, 1921, in all of which it caused the temperature to fall steadily to normal in a short time. Treatment for a few days only was sufficient to cure the patients. In all these early reports, no definite proof was given that the cases treated were truly malarial in origin. Presumably purely clinical spot diagnosis was the criterion employed without any laboratory examination of the blood for the presence of parasites. It is therefore difficult to give much credence to such findings.

During the period that the chemotherapeutic studies were proceeding, a tincture (1 in 10), containing approximately 1.3 gr. TAS per ounce, was prepared from the powdered bark of *Alstonia scholaris* and this was administered in doses of one ounce thrice daily in a few patients suffering from malaria. Authentic records of only 6 cases are available, but more than a dozen patients were treated. In 4 cases, malarial infection was definitely proved by the demonstration of parasites (BT parasites in one and MT parasites in three). In 2 cases, the presumption was drawn from symptoms and previous history associated with palpable spleen but parasites were not detected in the peripheral blood, at the time of admission. In none of these cases, according to the opinion of the physicians in charge, did the tincture of alstonia produce any remarkable febrifugal effect or alter in any significant way the course of the disease. The temperature chart of 3 patients, however, showed a distinct drop in fever almost immediately following or about half hour after doses of the tincture were administered. The patients appeared during these periods to be comparatively free from subjective symptoms such as headache, nausea, etc. On critical examination, this mild reduction in temperature has been ascribed by the physicians to simultaneous coincidence rather than to any direct effect of the drug. At any rate, no demonstrable anti-malarial action could be proved. It is possible that the slight reduction in temperature may be the result of central action of TAS contained in the tincture, as is

TABLE

*Alstonia scholaris* alkaloids in monkey malaria (*P. knowlesi*)

| Serial number | Weight of monkey and date of inoculation | Date of commencement of treatment | Daily dosage in mg. and number of daily doses | NUMBER OF PARASITES PER 10,000 R.B.C. |  | REMARKS  |
|---------------|--|-----------------------------------|---|---------------------------------------|--|--|
|               |  |                                   |   | Before treatment                      | During treatment                                 |  |
| I             | 2.5 kilo, 23-5                           | 27-5                              | (1) 50<br>(2) 50<br>(3) 60<br>(4) 80<br>4     | 840                                   | (1) 3,590<br>(2) 5,600<br>(3) 6,820<br>(4) 6,920 | Quinine gr. 2 given on 1-5. Monkey found dead 2-5 morning.   |
| II            | 2.5 kilo, 12-6                           | 14-6                              | (1) 50<br>(2) 50<br>(3) 50<br>3               | 5                                     | (1) 220<br>(2) 460<br>(3) 2,430                  | Quinine gr. 1 given on 17-6. Monkey found dead 18-6 morning.   |
| III           | 2.6 kilo, 17-6                           | 20-6                              | (1) 50<br>(2) 50<br>2                         | 50                                    | (1) 350<br>(2) 1,410                             | Quinine gr. 1 given daily 22-25-6. Parasite counts:—1,840—130 (26-6), 230 (30-6)—70 (9-7) chronic infection established. |
| IV            | 3.0 kilo, 20-6                           | 22-6                              | (1) 60<br>(2) 60<br>2                         | 120                                   | (1) 320<br>(2) 1,220                             | Quinine gr. 1 given daily 24-28-6. Parasite counts:—1,440-120 (1-7), 60 (2-7)—nil.                                       |

observed after the administration of centrally-acting antipyretics.

#### Summary and conclusions

Careful investigations in the laboratory and in the clinic of the total alkaloids isolated from *Alstonia scholaris* (N. O. Apocynaceæ), and also of a tincture (1 in 10) made from the powdered bark show that, contrary to popular belief and the earlier records of clinical trials with the drug, *Alstonia scholaris* has little or no demonstrable action in malaria induced in monkeys or naturally occurring in human patients. It cannot therefore be recommended as a substitute for quinine and other cinchona alkaloids.

#### Acknowledgment

The authors would like to record their thanks to Dr. L. E. Napier, Director, School of Tropical Medicine, for permission to carry out this collaborative study, and to Professors S. Ghosh and B. M. Das Gupta for placing the facilities of their respective laboratories at the disposal of the workers.

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#### ECONOMY AND SIMPLIFICATION IN THE STAINING OF BLOOD SLIDES

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With the Technical Assistance of E. Koechler

THE stains commonly used for staining blood films (Giemsa's, Wright's, Leishman's, etc.) have become expensive, and in many cases difficult to obtain. In order to get the best results with these stains, acetone-free alcohol and distilled water of a specified pH are necessary. This again increases costs and complicates technique. Furthermore, films, and particularly thick-drop slides, are usually stained by flooding, which means that the stain is discarded after having been used for a single slide only.

It is the object of this paper to show how a stain devised by Boyé (1940)—during the present campaign in North Africa—for the staining of thick drops can be used in such a way as to make it suitable for routine laboratory blood-film staining in all cases in which the Romanowsky stains are generally used.

The advantages of the methods we are about to describe are that:—

- The stain itself is 'home-made'.
- It contains no alcohol.
- It is suitable for staining by immersion instead of flooding.
- It does not appear necessary to be fastidious about the pH of the distilled water employed in its manufacture.
- It improves with use.
- It reduces the time required for processing drops and films to a matter of seconds.
- The results are perfectly satisfactory for all routine clinical work.

The stain consists of two solutions which, following Boyé's (1940) and Stévenel's (1918) directions, are prepared as follows:—

*Solution 1 (eosin solution)*

|                       |               |
|-----------------------|---------------|
| Eosin pure .. ..      | 1.0 gm.       |
| Distilled water .. .. | 1,000.0 c.cm. |

*Solution 2 (Stévenel's blue)*

1. Medicinal methylene blue .. 1.0 gm.  
Distilled water .. 75.0 c.cm.  
(Dissolve completely.)
2. Potassium permanganate .. 1.5 gm.  
Distilled water .. 75.0 c.cm.  
(Dissolve completely.)
3. Mix (1) and (2) in a flask. A massive precipitate forms at once. (In the abstract of Stévenel's paper, it is said that almost complete decolorization of the liquid takes place. If this is meant to imply that it becomes colourless, we must mention that we have never observed this. The mixture changes colour through various shades of violet, but we have never seen it become colourless; perhaps *discoloration* is meant.)
4. The flask is kept in a water-bath at boiling point for half an hour during which the precipitate re-dissolves.
5. Filter. The stain is now ready for use: it requires no further dilution.

For staining single slides, we use small glass cylinders  $1\frac{1}{2}$  inches in diameter and  $3\frac{1}{2}$  inches high, which, when not in use, are closed with greased watch-glasses to prevent evaporation. The contents of these cylinders decrease very slowly through the lifting out of wet slides. The loss is replaced by adding from stock. Apart from these small additions, we have stained more than a hundred slides with about 60 c.cm. of each stain before we have noticed the slightest evidence of deterioration. In fact, the more the stain is used, the better it appears to become. This does not seem to be due to 'ripening', as old stock is not as good as well used solution. The improvement is possibly due to the transfer, in spite of rinsing, of traces of eosin to the Stévenel solution, and *vice versa*. The water adhering to the slide after rinsing appears to be sufficient to counteract any change in concentration of the stain due to evaporation.

With this stain we have been able to discontinue altogether the use of distilled water for rinsing. We use boiled or stored tap water only. Water, as it comes from the tap in Satara, cannot be used as it is too highly aerated after passing through a hydro-electric plant before distribution, and therefore covers the slides with a layer of air-bubbles.

We fix our thin films by immersion for one minute in a cylinder—similar to those used for the stain—containing ordinary rectified spirit. We have found that, in an emergency, commercial methylated spirit serves the purpose almost as well, the same spirit being used repeatedly. We have found that a satisfactory dehaemoglobinization of thick drops can be obtained by immersion in tap water without risk of the 'drop' becoming detached from the glass.

It is, however, necessary that the following precautions be scrupulously observed:—

(a) The slides must be perfectly cleaned by boiling in soapy water, and subsequently rinsed

(b) They must be kept quite free from finger-prints, by handling at the edges only.

(c) Care must be taken to avoid touching the patient's finger with the slide when charging it with blood.

(d) The drop must be evenly and finely spread and allowed to dry properly in a horizontal position.

The time required for dehaemoglobinization depends on the thickness of the drop and on the time it has been allowed to dry. If it is dehaemoglobinized as soon as it appears dry, one minute is usually sufficient. If some hours elapse after taking the blood, or if the film is very thick, it may take 5 to 10 minutes. Dehaemoglobinization is complete when the blood has lost all colour and is hardly visible.

We always clean the skin for puncture with commercial petrol which, apart from its cheapness, has better cleansing properties and is a more effective grease solvent than alcohol.

We have found the ordinary lance eraser no. 4 manufactured by Perry & Co., and widely used for retouching photographic negatives, by far the most satisfactory instrument for puncturing the skin. These erasers can be bought from any stationer like ordinary nibs and are so cheap that they can be discarded as soon as they get blunt. They are readily sterilized in any number which saves time in mass work. They make a superficial, clean cut which produces a far better flow of blood, and hurts less than a prick. They are very suitable for spreading thick drops. It is impossible to spread a thick drop evenly with a needle.

For the immersion method of staining, the end of the film should be well in the second half of the slide as this is the most important part, both for differential counting and malaria parasites (see figure 1-a).

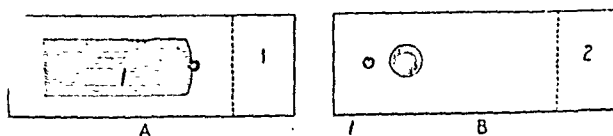


Fig. 1.

A. Correct shape and position of thin film. The slides are immersed up to the dotted line, and identified with grease pencil beyond the line.

B. Correct position and size of thick drops. Two drops should be made. In the figure, the first drop shows the correct size before spreading as it should be taken from the puncture. The second drop shows the size to which it should be spread with the lance eraser.

The thick drops should be placed and spread as shown in figure 1-b. It is important that the drop should be small, and left to dry in a horizontal position flat on a table.

*Procedure for staining thin films*

|                                       |          |           |
|---------------------------------------|----------|-----------|
| 1. Fix by immersion in spirit ..      | 1 minute |           |
| 2. Rinse with tap water ..            |          | 4 seconds |
| 3. Immerse in eosin solution ..       | 10       | "         |
| 4. Rinse with tap water ..            | 4        | "         |
| 5. Immerse in Stévenel blue ..        | 15       | "         |
| 6. Rinse with tap water ..            | 4        | "         |
| 7. Immerse again in eosin solution .. | 5        | "         |
| 8. Rinse with tap water ..            | 4        | "         |

Total time required .. 1 minute 46 seconds

Allow to dry in upright position.

*Procedure for staining thick drops*

|  |          |            |
|--|----------|------------|
| 1. Dehaemoglobinize by immersion in tap water in beaker no. 1 .. | 1 minute |            |
| 2. Immerse in eosin solution ..                                  |          | 20 seconds |
| 3. Rinse by dipping into tap water in beaker no. 2 ..            | 4        | "          |
| 4. Immerse in Stévenel's blue ..                                 | 30       | "          |
| 5. Rinse by dipping into tap water in beaker no. 3 ..            | 4        | "          |
| 6. Immerse again in eosin solution ..                            | 10       | "          |
| 7. Rinse by dipping into tap water in beaker no. 2 ..            | 4        | "          |

Total time required .. 2 minutes 12 seconds

The microscopic appearance of such slides is almost the same as we obtain with the Romanowsky methods, the only difference being that eosinophil leucocytic granules have an orange tinge instead of the usual brick-red. All nuclear and protoplasmic characteristics of leucocytes and lymphocytes are beautifully clear and typical. Malaria chromatin appears a bright ruby colour, and the protoplasm pale blue. The latter stands out clearly from the red cells. Malaria pigment is black, and crescents are indistinguishable from those obtained with a perfect Giemsa's stain.

In the thick drop, malaria parasites usually appear somewhat different from those in thin films, owing to the process of dehaemoglobinization. MT rings look like a semicolon with the comma lying in a horizontal position. The dot is bright red, and the comma light blue. Crescents appear the same as in thin films. BT parasites are irregularly shaped and frequently show no clear outline, but they are very easy to recognize by the combination of blue protoplasm, red chromatin, and black pigment. In quartan, the pigment has a golden tinge. The characteristic band-forms do not appear in the thick film. There is for practical purposes no difference between a really good Giemsa-stained thick drop and the result of the method we have described. As the thick-drop method is still not very popular in India, we may be permitted to remark that its great advantage lies in the fact that it makes a positive malaria diagnosis possible with a single glance through the microscope. Even in a very mild infection in which it may be necessary to make a long search in the ordinary film, 1 to 2 parasites are usually found in every field in the thick drop. In medium and heavy infections,

they are correspondingly more numerous, 20 to 40 parasites per field being quite common. It has been our experience that if 15 fields show no parasites in a properly made and well-stained thick drop, a negative report may be returned with confidence. When examining a thick drop, it is advisable to work from the edge towards the centre, because at the edge there is no visible red corpuscular residue so that the malaria parasites and the leucocytes appear on a clear background. With a little practice it is possible to examine and diagnose correctly 25 thick-drop slides in 15 minutes; if the percentage of positives is high this can be done in still less time. Hitherto the disadvantage of the thick film was that really good slides could be obtained only by Giemsa's method, and this required half an hour for staining. With the rapid method here described this drawback has been overcome.

The present necessity for strictest economy in the prescribing of antimalarial remedies makes it necessary to explore every route by which antimalarial drugs can be saved. One very important source of waste is the indiscriminate prescribing of quinine for undiagnosed fevers. In places where microscopic facilities are available it should be possible to insist on an exact diagnosis by blood examination and to restrict the prescribing of quinine to those cases in which parasites are found. This would result in a very considerable saving of quinine. Caplan (1942) in this journal has already called attention to the importance of parasitological diagnosis as a method of saving quinine. He compares statistics which are so illuminating that we cannot resist the temptation of quoting him:—

'Hospitals A and B dealt with an equal number of patients from the same localities. Hospital A performed about 80 blood examinations every year and B about 5,000. During the same year Hospital A reported over 11,000 cases of malaria and Hospital B under 800.'

This means that in Hospital A over 10,000 cases were unnecessarily treated with quinine in a single year. If we calculate that each case received the quite inadequate dose of 5 grammes, the total waste of quinine would amount to about 5 kilograms (or over 10 lb.) of quinine. If each case received an adequate quantity of quinine the waste in a single hospital would amount to 15 to 25 kilograms (over 30 to 50 lb.) per annum. The quantity usefully employed in actual cases of malaria would be less than one-tenth of the total consumption. It can be fairly said that, in India, Hospital A is the rule and Hospital B the exception. The resulting stupendous waste of a priceless drug could be eliminated to a great extent if microscopes were used to capacity for parasitological diagnosis.

Such a proposal is, however, usually met with the objection that in busy out-patient departments there is neither sufficient staff nor time

to do blood examinations. In order to counter this argument, we have worked out a method by which large numbers of blood slides can be taken, stained, and examined in minimum time at nominal expense.

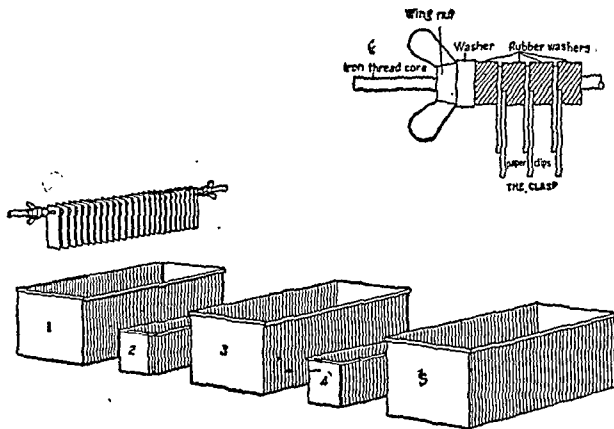


Fig. 2.—Tank 1. Tap water for dehaemoglobinizing. Tank 2. Eosin solution. Tank 3. Tap water for rinsing eosin. Tank 4. Stévenel's blue. Tank 5. Tap water for rinsing blue.

The necessary equipment (figure 2) consists of two small (9 inches  $\times$  2 inches  $\times$  3 inches) and three large (9 inches  $\times$  5 inches  $\times$  5 inches) enamel tanks (ours were very kindly made to specification, and supplied gratis by Messrs. Ogallie Glass Works, Ogalliewadi) and a clasp to hold 25 slides which are simultaneously processed. We have experimented with and constructed a large variety of clasps, and have found the following the most satisfactory:—

Twenty-five ordinary wire paper clips are threaded on to a snugly fitting metal core. The clips are separated from each other by  $\frac{1}{4}$ -inch thick rubber washers cut from ordinary thick pressure tubing (such as is used for stethoscopes). The metal core must be 11 inches long, so that it can rest on the edges of the enamel tanks. It has a thread cut at each end over which a large winged nut is screwed. A steel washer is inserted between the rubber and nut. The nuts when screwed down compress the rubber washers so that they grip the paper clips firmly. This arrangement makes it possible to replace clips that have become worn out or bent.

Contrary to expectation, thin slides are so firmly held by these clips that the clasp can be shaken without any slides falling out. The slides should be inserted into the clasp sideways as shown in the illustration (figure 2). The large tanks contain tap water for dehaemoglobinizing and rinsing. The small tanks contain the staining solution. The tap water should be renewed after every 50 slides. The stains (600 c.cm. for each tank) should be renewed after every 1,000 slides. The staining process is the same as described above for single thick-drop slides.

Let us suppose that on a given day 25 patients, suspected to be suffering from malaria, attend an out-patient department. The procedure of blood examination would then be as follows:—

1. Collect the patients. Prepare 25 slides numbered with grease pencil 1 to 25, and place in rows on a table.

2. Take each patient in turn. Paint the number of his slide on the back of his hand with gentian violet (this saves paper and clerical work). Puncture finger after wiping with petrol swab. Wipe with dry cotton-wool. Charge slide with two drops. Spread drops with eraser and replace in row to dry (beware of flies). In this manner a practised technician can take blood samples from 25 persons in less than .. .. 15 minutes
  3. When dry, the slides are inserted in the clasp, stained as described above and again left to dry. Time required (drying excluded) .. .. 4 "
  4. Remove from clasp and examine microscopically. Place positive slides apart, or mark with grease pencil. Time required for examining 25 thick-drop slides for malaria .. .. 15 "
- 
- Total time required for 25 blood examinations .. .. 34 minutes

In other words, a complete parasitological diagnosis of malaria requires approximately a minute and a quarter per case. This may sound incredible, but actually the times we have given are generous; a practised and dexterous technician can work faster still, particularly if he is assisted by an intelligent servant. Where larger numbers of slides are processed the average time for each slide is still further decreased by working with overlapping series of twenty-five.

We feel that this amount of time can be devoted to malaria cases in every out-patient department equipped with a microscope. The thick-drop method of serial examination is so simple that it does not require the attention of a senior medical officer. Even unqualified technicians can be most reliable if properly instructed.

If a shortage of antimalarial remedies forces us to popularize the parasitological diagnosis of malaria, it will at least have one welcome consequence.

### Summary

1. Preparation of a new, simple, and cheap stain devised by Boyé is described.
2. Measures for economy in the preparation of slides are discussed.
3. Procedures for staining thin films for differential leucocyte count and malaria parasites are described.
4. Procedures for staining thick drops for malaria parasites are described.
5. General remarks on thick-drop examination are made.
6. A quick, cheap and simple method of serial blood examination for malaria is suggested with the object of encouraging parasitological diagnosis as a means of economizing anti-malarial remedies.

[Note.—This method of staining has been tried by us, and found excellent for thick films, and useful but not ideal for thin films.—EDITOR, I. M. G.]

(Concluded on opposite page)

# AN INVESTIGATION INTO THE TOXICITY OF SULPHANILAMIDE IN ALBINO RATS AND THE PROTECTIVE EFFECT OF NICOTINIC ACID

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THE introduction of the sulphonamide group of drugs of which the parent substance is sulphanilamide (p-amino benzene sulphonamide) marked a renaissance in chemotherapy and these drugs have a wide clinical applicability to-day. As to every other chemotherapeutic remedy a number of toxic reactions has been ascribed to them. These reactions are many and varied and, in some instances, of a serious nature. Most of the symptoms, *e.g.*, headache, vertigo, anorexia, nausea, vomiting, general malaise, palpitation, prostration, cyanosis, etc., are relatively mild. More serious are skin reactions with the occasional occurrence of exfoliative dermatitis and lesions of the hæmopoietic system such as agranulocytosis, acute hæmolytic anæmias, jaundice, etc. A number of other symptoms has been reported which include stomatitis, diarrhoea, peripheral neuritis and psychoses.

Various measures have been advocated to guard against the danger of undesirable toxic effects following the administration of sulphonamides. Of these the following may be mentioned: avoidance of sulphur in any form and purgatives in general (except liquid paraffin) with the object of preventing the formation of sulphæmoglobinæmia; methylene blue (Wendel, 1939) has been of value in removing the cyanosis due to methæmoglobinæmia; the administration of sodium lactate (Hartmann, Perley and Barnett, 1938a) and sodium bicarbonate (Lucas and Mitchell, 1939) has been suggested to prevent fall in CO<sub>2</sub> capacity and to counteract acidosis and renal injury, but the use of the latter as a routine measure has been criticized (Hartmann *et al.*, 1938b); acute toxic symptoms produced by sulphanilamide have been found to be reduced by the simultaneous administration of sodium acetate (James, 1939, 1940); vitamin C (ascorbic acid) has also been reported to be effective in preventing undesirable reactions (Dainow, 1939); vitamin B<sub>1</sub> (thiamin chloride) has been suggested by Findlay (1939). According to McGinty, Lewis and Holtzclaw

(1939) and Cottini (1940), nicotinic acid ( $\beta$ -pyridine carboxylic acid) has been successfully used for the same purpose.

The object of the present investigation was to observe the effect of the administration of nicotinic acid on acute toxic reactions produced by sulphanilamide in rats. It is now known that patients treated with sulphanilamide excrete porphyrin in the urine which has been found to be chiefly porphyrin of type III (Rimington and Hemmings, 1938). Rimington and Hemmings (1939) after further work have tentatively suggested that sulphanilamide, by causing methæmoglobinæmia and increased destruction of erythrocytes, brings about an increased excretion of type III porphyrin derived from the broken-down blood pigment, and have pointed out that the porphyrinuric action of drugs of the sulphonamide group appears to run parallel with their toxicity. The toxic reactions produced by sulphanilamide bear a certain resemblance to the manifestations—both the premonitory symptoms and the diagnostic syndrome—of pellagra. In pellagra there is also an increased excretion of porphyrin type III (Editorial, 1939) and nicotinic acid has a curative action in this disease. These facts indicate that nicotinic acid may have a protective effect against the toxic manifestations produced by sulphanilamide.

## Experimental

Various doses of sulphanilamide were used to determine the lethal dose for rats. The 'characteristic mortality' produced by different doses was studied, and the median lethal dose (LD 50) was ascertained. The latter is the dose which will kill 50 per cent of a sufficient number of animals (Trevan, 1927). The possibility of modifying the mortality of rats receiving LD 50 by the administration of nicotinic acid was then studied. In one group of experiments, the median lethal dose was given as a single dose preceded and followed by the administration of nicotinic acid. The latter was given 2 to 3 hours before, and 4 to 6 hours after, the dose of sulphanilamide. In another group of experiments, the median lethal dose of sulphanilamide was given in three portions within a period of 24 hours, each administration being preceded by a dose of nicotinic acid given 2 to 3 hours before. The idea underlying the second group of experiments was that the sudden administration of a heavy dose of sulphanilamide might exert a toxic effect too rapidly for an antidote to exert a protective action.

The animals used were rats of the albino stock of the Nutrition Research Laboratories, Coonoor. Both male and female rats were used, the body weights varying from 60 to 150 grammes. The animals were fed on a diet consisting mainly of rice and poor in nicotinic acid. Sulphanilamide tablets (Parke, Davis & Co.—p-amino benzene sulphonamide) were pulverized, and the requisite quantity, calculated on the basis of body weight, was given orally

(Continued from previous page)

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to fasting animals in the form of a pellet made with a little sugar and water. There was no difficulty in giving the animals sulphanilamide in the manner described. The amount of nicotinic acid given daily as an antidote was 625  $\mu$ g. throughout the investigation. This was administered in solution by mouth through a graduated pipette. The choice of this average dose was reached after a consideration of doses in cases of human pellagra as suggested by Spies (500 mg. daily) and also depended on the fact that preliminary observations showed a dose of this order to be innocuous.

#### Median lethal dose

The toxic effect produced by the oral administration of various doses of the drug was studied in 104 rats. The results are shown in table I and represented graphically in figure 1.

TABLE I

Mortality resulting from various doses of sulphanilamide

| Dose per kg. of body weight. | Number of rats used | Number dying | Percentage mortality |
|------------------------------|---------------------|--------------|----------------------|
| 3.5 grammes                  | 10                  | 0            | 0.0                  |
| 4.5 "                        | 24                  | 5            | 20.8                 |
| 5.5 "                        | 30                  | 15           | 50.0                 |
| 6.5 "                        | 25                  | 19           | 76.0                 |
| 7.0 "                        | 15                  | 13           | 86.6                 |

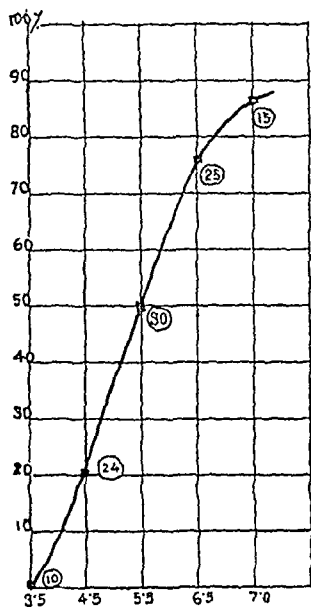


Fig. 1

The expected mortality from any given dose, and vice versa, can be ascertained from the figure. The LD 50 was 5.5 grammes per kilo

of body-weight. Statistical calculations indicate that the actual range of the number of expected deaths at this level of dosage was  $15 \pm 8.22$ , or, expressed as a percentage,  $50 \pm 27.4$ , with an approximate probability of 0.9973. Conversely, the range of possible doses which give rise to a mortality of 50 per cent is  $5.5 \pm 18.15$  per cent, i.e., from 4.6 to 6.6 g. per kilo of body-weight.

These figures for lethal doses are not in agreement with those obtained by other workers for rats. Halpern and Mayer (1937) reported LD 90 to be 4 g./kg. In the experiments of Murayama and Leake (1938) doses of 4, 5, 6, 8 and 10 grammes per kg. produced mortality rates of 20, 29, 36, 40 and 50 per cent respectively. The results of the present investigation correspond, in general, to those of Molitor and Robinson (1939), who found LD 50 to be 6.2 g. It is difficult to explain the cause of these wide variations. Age has been mentioned by Molitor and Robinson (*loc. cit.*) as a possible factor in variation. It is possible that the strain of rats used and their diet may have some significance. In one experiment (not reported in this series) it was found that a group of rats receiving a diet of wheat and milk was definitely less susceptible to the toxic action of the drug than rats fed on the rice diet.

*Acute toxic reaction.*—The signs of the acute toxic reaction leading to death were as follows:—

The effects of poisoning appeared in 2 to 8 hours, usually between 3 and 4 hours. The animals became less active, but showed suggestions of 'agitation'. They refused food. Thirst developed. Even in the early stages the rate of respiration was obviously increased. Later, the animals became more restless, showing diverse purposeless incoordinated movements. Weakness and paralysis of the limbs followed. At this stage severe clonic convulsions lasting a few seconds usually occurred. The convulsions gradually diminished in frequency, and the animals passed into a comatose state with limbs extended and rigid, with very rapid respirations. Death ensued. Some animals showed bleeding from the gums and the nose. Most of the deaths occurred between 24 and 48 hours after administration of the drug. The earliest time was 12 hours and the latest 74 hours.

*The protective effect of nicotinic acid in rats receiving 5.5 g./kg. of sulphanilamide (LD 50)*

Further experiments were carried out in which the protective effect of nicotinic acid was investigated. In these experiments, groups of animals similar in age and sex composition were observed, one group receiving 5.5 g./kg. of sulphanilamide only and another group nicotinic acid in addition to this dose of sulphanilamide. The results obtained in experiments in which sulphanilamide was administered as a single dose are shown in table II.

TABLE II

*Effect of nicotinic acid on mortality from sulphanilamide poisoning*

| Group                                      | Number of animals | Number of deaths | Percentage mortality |
|--|-------------------|------------------|----------------------|
| Receiving sulphanilamide only.             | 30                | 15               | 50.0                 |
| Receiving sulphanilamide + nicotinic acid. | 30                | 7                | 23.3                 |

The difference in the percentage mortality in the two groups is statistically significant at a 0.03 level of significance.

In another group of experiments, the median lethal dose of sulphanilamide was given in three portions. Here a distinction was made between severe and mild toxic reactions and the groups were compared on this basis. The absence of convulsions and recovery was taken as the criterion of a mild reaction. The results are shown in table III. Animals showing mild manifestations include those showing no toxic signs at all, while a number of animals dying (figures in parenthesis in table III) is included in the group showing severe reactions.

TABLE III

*Effect of nicotinic acid on the exhibition of mild and severe reactions to sulphanilamide poisoning—LD 50 administered in divided doses*

| Group  | Number of animals | Mild reaction | Severe reaction | Percentage of severe reactions |
|--|-------------------|---------------|-----------------|--------------------------------|
| Receiving sulphanilamide only (divided doses). | 30                | 9             | 21 (6)          | 70.0                           |
| Receiving sulphanilamide + nicotinic acid.     | 30                | 16            | 14 (3)          | 44.6                           |

N.B.—Figures in parenthesis indicate deaths.

Statistical analysis showed the difference in the percentage of severe reactions in the two groups to be statistically significant, at 0.01 level of significance.

It will be observed that the mortality in the 30 animals receiving sulphanilamide in divided doses (table III) was 6, while that in the 30 animals receiving the same amount in single dose without any nicotinic acid (table II) was 15. The difference is striking and shows that the administration of a single heavy dose of the drug is more dangerous than the same dose given in divided portions. In clinical practice, the drug is usually given in small and divided doses, and deaths during therapy are rare. In

the second group of experiments, in which sulphanilamide was given in divided doses, conditions thus correspond more closely with those obtaining in clinical practice, and here the efficacy of nicotinic acid in preventing severe toxic reactions was strikingly apparent.

### Discussion

The following lethal doses of sulphanilamide for different animals have been reported by various observers :—

| Animals       | LD 50 g./kg. (oral) | Authors                        |
|---------------|---------------------|--------------------------------|
| Rabbit ..     | 2.0                 | Raiziss <i>et al.</i> , 1937.  |
| Guinea-pig .. | 2.5                 | Domagk, 1935.                  |
| Mice ..       | 3.5                 | Marshall <i>et al.</i> , 1938. |
| Rats ..       | 6.2                 | Molitor and Robinson, 1939.    |

A similar figure (LD 50) for dogs is not available; the number of dogs used in experiments in sulphanilamide poisoning has been small. Halpern and Mayer (1937) found the oral toxic dose to be 1 g./kg. Molitor and Robinson (1939) reported that 2 g./kg. by mouth produced severe symptoms in all animals, but mentioned the important fact that after large doses the dogs usually vomited early and the experiments had to be discontinued. In general it may be stated that dogs are quite susceptible.

It is an interesting fact that rats should have a tolerance for the drug which other animals, especially dogs, have not. The fact that rats can synthesize nicotinic acid (Shourie and Swaminathan, 1940) may be of significance.

Reference has already been made to clinical observations on the beneficial effects of nicotinic acid on acute sulphanilamide poisoning. The results reported in the present investigation, as far as they go, support these clinical findings.

### Summary

1. In oral toxicity experiments the LD 50 of sulphanilamide was found to be 5.5 ( $\pm$  18.15 per cent) grammes per kilogram in rats.
2. Nicotinic acid when administered along with this dose of sulphanilamide (LD 50) to rats reduced mortality to a significant extent and limited the occurrence of severe reactions.

### Acknowledgments

This investigation was carried out in the Nutrition Research Laboratories, Indian Research Fund Association, Coonoor, while the author was attending the nutrition class in 1941. He wishes to express his gratitude for the facilities offered and for help and encouragement. He acknowledges the help of Dr. W. R. Aykroyd in the preparation of the paper.

The author desires also to express his indebtedness to Dr. M. N. Bose, Principal, and Dr. B. N. Ghosh, Professor of Pharmacology, Carmichael Medical College, for granting him the necessary leave to complete the investigations, and to his

(Concluded on next page)

## A CLINICAL SIGN IN SANDFLY FEVER

By J. C. SHEE, M.B., M.R.C.P. (Lond.)

CAPTAIN, R.A.M.C.

THE purpose of this paper is to describe a clinical sign which is easily elicited, and which appears to be present in the majority of cases of sandfly fever, and which, as far as I am aware, has not been recorded before. The sign consists of choking of the optic discs, which varies in its slighter manifestations from blurring of the edges of the discs, with distention of the retinal veins, up to a papilloedema with a swelling of about 2-2.5 D. Exudates or retinal hæmorrhages have not been observed.

The sign was observed in cases occurring in a non-immune group of British troops recently arrived from Britain, amongst whom the disease was of frequent occurrence.

**Cases.**—Of a total number of thirty cases which presented the clinical criteria of sandfly fever, the sign was present in twenty-seven. The three cases in which it did not occur were very mild with only very slight headache.

(Continued from previous page)

chief, again, for his constant encouragement and valuable advice in connection with this work.

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The clinical criteria applied were (1) sudden onset often with rigor, (2) flushing of the face limited by the collar line, (3) injection of the conjunctivæ, (4) supra-orbital or post-orbital headache, with tenderness on pressure over the globes, (5) backache and stiffness in the back of the neck, (6) pyrexia of from 48 to 96 hours' duration, (7) bradycardia, (8) slight leucopenia, or normal white cell count (4,000-7,000 cells per cubic mm.), (9) Vesication of palate and fauces, thought to be inconstant and rather unreliable, (10) slow convalescence seen in some cases, (11) exclusion of any other infection, especially malaria.

Cases were seen within 6 to 48 hours of onset; the sign was present in the earliest cases seen, although it sometimes became more marked on the second day. The swelling of the disc was usually most obvious in the eye in which the globe was most tender, or on the side with the most severe supra-orbital or post-orbital pain. In the slighter cases the swelling subsided rapidly; in the more severe cases it was still apparent on the day after the patient had become apyrexial.

One case not included in the 30, which was considered clinically to be sandfly fever, and which showed papilloedema after a protracted convalescence, developed catarrhal jaundice on the 15th day. Another case also not included in the series, which showed the typical clinical picture with papilloedema, tenderness of the globes and a negative blood film, and in which the temperature showed a tendency to rise rather than settle, was then found on the third day to have subtertian ring forms in the blood. These cases I consider to have been possible examples of sandfly fever, with a concurrent or consecutive other disease, although cerebral malaria has been described as sometimes showing papilloedema associated with amaurosis.

## Discussion

Visual acuity tests were not carried out in any case, but it was noticed that sandfly-fever cases were photophobic and generally averse to using their eyes, as in reading.

The papilloedema is probably due to the associated rise in cerebro-spinal fluid pressure which has been reported in this disease by Le Gac and Albrand (quoted in Manson's *Tropical Diseases*, 11th edition, 1941). Owing to the conditions (Indian Frontier) under which I saw the cases, cerebro-spinal manometry was not practicable, and as morphia gr. 1/6 hypodermically was invariably found to relieve the headache, lumbar puncture was not instituted in any case for the relief of this symptom.

## Summary

(1) Some degree of papilloedema was observed in twenty-seven out of thirty cases of clinical sandfly fever.

(2) This sign taken in conjunction with the other clinical findings should be of assistance in the early diagnosis of the disease.

# A Mirror of Hospital Practice

## A CASE OF DIPHTHERIA OF THE GLANS PENIS

By JAGDISH SINGH, F.R.C.S. (Eng.), F.R.C.S.E.,  
D.L.O. (Lond.)

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THE common sites for the occurrence of local lesion of diphtheria are the fauces, laryngeal and nasal mucous membranes. It is mentioned in books, however, that diphtheria may involve the genitals and the skin on any part of the body. I have not read the description of a case of diphtheria of the glans penis in the literature. The case described below is, therefore, of unusual interest.

*History.*—B. K., a Hindu boy of 5 years, was sent by his parents for an ulcer on the glans penis and sleeplessness. The ulcer was of 12 days' duration. Constant irritation interfered with the child's sleep.

*Clinical examination.*—On examination the child did not look seriously ill. There was slight sanious discharge from the orifice of the prepuce. Inguinal glands on both sides were moderately enlarged but not tender. The prepuce could be retracted without difficulty but it caused a good deal of pain to the little patient. There was an area  $\frac{3}{4}$  by  $\frac{1}{4}$  inch on the dorsum of the glans penis extending from the corona glandis to within a short distance of the external urinary meatus, covered with the typical greyish false membrane. The case was diagnosed clinically to be one of diphtheria. There was no lesion in the throat. The temperature was 98°F. and pulse 100 per minute. Smears were examined microscopically and bacilli morphologically resembling diphtheria bacilli were identified. No other micro-organisms were seen.

*Treatment.*—Anti-diphtheritic serum 30,000 units was administered intramuscularly but no local treatment was carried out.

*Subsequent progress.*—The symptoms began to subside gradually. The child had better sleep the same night. The following morning when the child was examined, the membrane was found to be broken up and thinner. It cleared up completely in 5 days. On account of satisfactory progress the serum was not repeated.

### Summary and comments

1. Diphtheria of the genitals is mentioned in books but cases involving the glans penis are very rare.

2. There seems to be very little toxæmia associated with such lesions.

3. A single dose of anti-diphtheritic serum of 30,000 units was followed by healing.

4. The possibility of an ulcer being diphtheritic should always be kept in mind.

### Acknowledgment

I am thankful to Dr. Amarjit Singh for bacteriological examination.

## A BRIEF NOTE ON THE USE OF CONGO RED IN PROTOZOAL DYSENTERY

By L. S. F. WOODHEAD

CAPTAIN, I.M.S.

Specialist in Pathology, British Military Hospital, Shillong

DURING the epidemic of protozoal dysentery among troops evacuated from Burma, most of

whom had come through the so-called 'Dry Belt', some had severe hæmorrhage *per rectum*. These cases had vegetative forms of *Entamoeba histolytica* in large numbers in the stools and these could be found even in the almost-pure blood passed. The usual routine treatment of emetine, bowel washes, salines, etc., had no effect on the hæmorrhage nor had the ordinary hæmostatic serum. In one case, the patient had had thirty-four motions in twenty-four hours, all of which were pure blood containing a few amœbæ.

It was decided to try the effect of intramuscular Congo red in the abovementioned case. 10 c.cm. of a 1 per cent solution in water were injected deeply into the buttock, 3 inches below the iliac crest, in the evening. The following morning there was a distinct improvement and the hæmorrhage had practically ceased. The injection was repeated the next evening (10 c.cm.) and again the next (5 c.cm.), a total of 25 c.cm. being given. By this time the general condition had greatly improved and there was no fresh blood in the stools, which had greatly decreased in number. The patient has improved since that time and is now almost fit for discharge—one month after the injections. There was slight discomfort at the site of injection but no real inflammation or abscess formation.

Another case was admitted in a bad condition, generally bleeding profusely. The same treatment was given with exactly similar results so far as hæmorrhage was concerned, but the patient died from pure exhaustion.

A third case admitted in a serious condition improved remarkably under the same treatment, and it almost fit for discharge.

Three other cases less serious than the others, and requiring less Congo red (15 c.cm. or 1 per cent solution), have been cured.

In none of these cases has any other treatment been used, and there has been no reaction of any kind, apart from some local tenderness over the site of injection.

It is now proposed to try the effect of Congo red on all types of protozoal dysentery in order to find out if it has any effect in controlling the diarrhoea. It is also intended to try the effect of this drug on the living amœba, and on cysts.

My thanks are due to Lieut.-Colonel J. A. C. Kidd, R.A.M.C., Officer Commanding The British Military Hospital, Shillong, for permission to publish this note.

## A CASE OF MULTIPLE FRACTURES

By A. L. SOM, F.R.C.S. (Ed.)

MAJOR, I.M.S.

A SEPOY, aged 36, was involved in a lorry accident, as a result of which he sustained 25 fractures involving 18 bones. He was admitted to a field ambulance and treated for shock, and splints were applied. On the fifth day after the accident he was evacuated to a casualty clearing station and came under the care of the author.

*Condition on admission.*—Pulse 116, respiration 24, temperature 100.8°F. General condition poor. Respiration abdominal in type, and patient was coughing out blood-stained sputum. He complained of pain in the chest, right leg and left forearm. Surgical emphysema was present over both sides of chest which on examination showed diminished breath sounds and dullness at the bases with a pleuritic rub on either side. There was tenderness and rigidity of right hypochondrium.

Clinical examination followed by x-rays showed the following injuries :—

(1) Comminuted fracture of the lower one-third of shaft of right femur with posterior and medial displacement of the lower fragment.

(2) Fracture at the junction of the middle and lower one-third of right femur.

(3) Fractures of shafts of left radius and ulna with forward, upward and medial displacement of lower fragments.

(4) Fracture of left clavicle with upward displacement of the medial fragment.

(5) Fracture of ribs, first to ninth inclusive (right) and third to seventh (left). Right first rib fracture 1 inch from the vertebral end. Second to seventh ribs (right) were fractured near vertebral ends and also at lateral convexities.

(6) Bilateral hæmo-pneumothorax.

*Treatment.*—Antiphlogistine to chest. Morphine grain  $\frac{1}{4}$ . Brandy 2 drachms six hourly.

Next morning under chloroform and ether anaesthesia, skeletal traction was applied to right femur by Kirschner wire through upper end of tibia. Put up on modified Braun splint. A plaster slab was fixed to posterior surface of thigh and knee. Forearm fracture was reduced and put up in plaster. Chest was strapped. Fractured clavicle was reduced and fixed by pad in axilla and strapping. Morphine grain  $\frac{1}{4}$  given twice and brandy at night. Antiphlogistine applied to chest.

*Progress.*—Patient had slight continuous temperature for 10 days and during this period his chest condition gave rise to anxiety. After that he was apyrexial till the 24th day when blood smears showed malignant tertian rings. Malaria was controlled by conservative methods and his general condition gradually improved.

Six weeks later, x-ray examination showed good position of radius and ulna with well-marked callus formation. Movements were good and rapidly became full except for slight limitation of pronation and supination which improved with active exercise.

There was slight posterior angulation of femur. The extension was removed and plaster spica applied with knee and hip in slight flexion.

Patient was evacuated to a General Hospital on the 47th day after admission in a very good general condition and with every prospect of full recovery of functional power in all limbs.

### Points of interest

(a) Recovery from as many as 25 fractures in one patient is considered unusual.

(b) Fractures of 14 ribs, 6 of them double, with accompanying damage to the lungs and pleuræ leading to hæmo-pneumothorax, surgical emphysema, hæmoptysis and fever.

(c) Fracture of the first rib is very unusual owing to its protected position. The clavicle of the same side was not fractured but the opposite one was fractured.

(d) General anaesthesia caused no obvious deterioration of the chest condition.

(e) Relapse of malaria infection.

I am grateful to Lieut.-Colonel B. S. Dhondy, I.M.S., for permission to report this case.

## AN UNUSUAL INJURY

By H. WILLIAMSON

LIEUTENANT-COLONEL, I.M.S.

THE following case seems worth recording because of the unusual injury and the easy approach to the elbow joint through rather dangerous territory :—

A young British officer, after a fall from a horse, had swelling of the right elbow and could not bend it fully. Stereoscopic x-rays showed that the base of the coronoid process of the ulna had been torn out and was in front of the joint. As the fragment could not be replaced by manipulation I decided to remove it.

*Operation.*—An incision was made along the outer border of the pronator teres, which was retracted inwards with the common flexors. The median nerve and the origin of the ulnar and radial arteries were drawn outwards. The branch from the median nerve to the common flexors was carefully exposed and gently retracted inwards, the dissection being deepened down to the joint in the space between the branch and the median trunk. The fragment of bone was now easily identified, cleaned of some fibres of the brachialis anticus and removed. The open joint was dusted with thiazamide powder, one stitch put in the capsule, the deep fascia sewn up and the skin closed with a subcuticular stitch.

Recovery was uneventful and movements are now normal; no weakness of the flexor muscles followed the gentle retraction of the supplying nerve.

## TETANIC CONVULSIONS APPARENTLY DUE TO ASCARIASIS

By U. N. SAHA, M.B., B.M.S.

*Medical Officer, Civil Hospital, Comilla*

ON 1st September, 1942, at about 8 p.m., a boy, aged 6 years, was brought to the hospital. His father stated that in the morning he complained of pain in the abdomen, especially in the umbilical region. In spite of the continuous dull pain he was given ordinary rice diet which he vomited. At about 5 p.m. convulsions started which gradually increased in intensity.

*On examination,* the patient was found unconscious and quiet. Eyes were broadly open, pupils were equal, not reacting to light, corneal reflex was sluggish. Muscles (including neck muscles) were flaccid but lock-jaw was present, foam was coming out of the mouth. Respiration 30 per minute, irregular. Pulse 100 per minute. Temperature 99°F. Lungs—scattered moist sounds were present at the bases. Superficial and deep reflexes were sluggish on both sides.

During my examination muscular contractions began from above down; the whole body was thrown into violent tonic contraction—opisthotonos and pleurothotonus. Eyes were wide open, corners of the mouth retracted, teeth clenched. Respiration was laboured and irregular; cyanosis was developing.

The fits gradually subsided after 10 minutes leaving the patient more devitalized and relaxed, but the lock-jaw persisted.

*Past and family history.*—The patient had an old ulcer on the left great toe resulting from an injury about a year ago. There was no family history of epilepsy or hysteria. History also excluded poisoning. About a month ago he vomited two round worms and very often complained of abdominal pain.

*Treatment.*—He was given morphine grain  $\frac{1}{4}$  and atropine grain 1/100, and was kept under observation in a quiet dark room. Next morning the patient was better having small contractions at long intervals.

The jaw could be opened during the interval. He regained some amount of consciousness. The abdomen was very tender.

1 Santonin 3 grains with 15 grains of sodium bicarbonate and 3 grains of calomel was given, followed after two

hours by one ounce of saturated solution of magnesium sulphate.

At noon he passed a large stool with four round worms. The stool was found full of ova of *Ascaris lumbricoides* and *Ancylostoma duodenale*.

There was no recurrence of any convulsion afterwards.

## TWO RARE COMPLICATIONS OF INTESTINAL AMOEBIASIS

By GERALD H. COORAY, M.B., B.S. (Lond.), M.R.C.S.,  
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THE two cases which are reported below illustrate two rare complications of intestinal amoebiasis.

The first case is an example of rupture of an amoebic abscess of the liver into one of the large bile ducts and subsequently into the pleural cavity and lung.

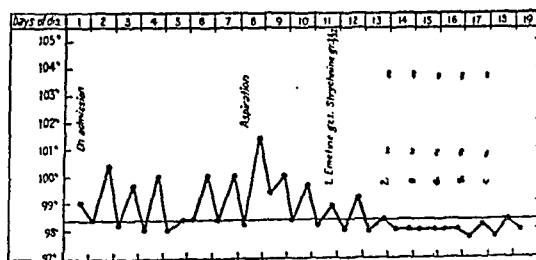
Although rupture of a liver abscess into the peritoneum and pleura is not an uncommon occurrence in the tropics, cases of rupture into a large bile duct are rarely seen. Only a very few cases have been mentioned in the literature [Annesley (1841), Waring (1854), Roughton (1891) and Hashimoto (1885)].

M. P., male, aged 30 years, was admitted to the General Hospital on 21st November, 1941, with pain in the chest and breathlessness of 2 weeks' duration. The onset was rather sudden. He had dysentery a few years ago. On examination he was dyspnoeic, pale and emaciated. Temperature was 99°F., and pulse 102 per minute. The heart was displaced to the left, but there was no enlargement. There were signs of fluid at the right base. The spleen was moderately enlarged. The liver which was palpable three fingers below the costal margin was markedly tender. There was also intercostal tenderness over the liver area. Dyspnoea, temperature, fluid at the right base with cardiac displacement, tenderness over the liver and the past history of dysentery made it possible to arrive at a tentative diagnosis of rupture of an amoebic abscess of the liver into the pleura. As the patient was dyspnoeic it was decided to explore the right pleural cavity. About three-quarter pint of chocolate-coloured thick fluid was withdrawn. The fluid on examination was free from organisms. The dyspnoea was temporarily relieved. He was put on a course of emetine injections. On the fifth day a second aspiration was arranged to be performed in the operating theatre, but just prior to operation, the patient coughed up chocolate-coloured fluid, which indicated that the abscess had burst into a bronchus. About 40 ounces of fluid were withdrawn from the pleural cavity. The patient was fairly comfortable and the temperature kept at a low level. The emetine was stopped after 12 injections were given. The lung signs however persisted. On the 24th day after admission the temperature suddenly shot up to 103.2°F. and the patient developed a troublesome cough. The sputum was yellow in colour and the presence of bile was evident to the naked eye.

The chest was aspirated the following day and thick yellowish bile-stained fluid was withdrawn. The presence of bile in the pleural fluid as well as in the sputum was confirmed by chemical tests. A white cell count done at this time showed a leucocytosis of 10,500 per c.mm. with 81 per cent polymorphonuclears. From this time the patient's condition gradually deteriorated in spite of a second course of emetine

injections. The temperature became hectic and the coughing of sputum mixed with bile persisted. The leakage of bile in the sputum was considerable as during this stage of his illness the stools were free

### CHART



from bile. His condition gradually deteriorated and he left hospital against medical advice.

### Discussion

This case presents interesting features. The patient's condition on admission leaves no doubt that he was suffering from the effects of the rupture of a liver abscess into the pleural cavity. Although no amoebae were detected in the stools, the nature of the fluid aspirated, the past history of dysentery and the physical signs indicated an amoebic origin of the abscess. The further spread of the abscess appears to be as follows: On the fifth day after admission it ruptured into a bronchus and was partly emptied by expectoration and partly by aspiration of the pleural cavity. This caused considerable relief, and a temporary improvement in his condition became apparent. The temperature settled down. The improvement was not maintained. There was a sudden rise of temperature and a troublesome cough with expectoration of bile. The abscess had ruptured into one of the large bile ducts and a communication was established between the bile duct, pleural cavity and bronchus. There was considerable escape of bile by expectoration. The leakage of bile in this manner probably interfered with his digestion and contributed to the steady deterioration of his condition. The hectic temperature and the leucocytosis during the last stage of his illness were probably due to cholangitis, the infection reaching the bile ducts from the respiratory tracts.

The second case is an example of primary amoebic infection of the lung. In the majority of cases the lung and pleura are involved by the perforation of a liver abscess, but in this case it will be seen that there was involvement of the pleura and possibly the lung while the liver escaped. Karunaratne (1940) in discussing this rare type states, 'it would seem that the hepatic barrier is not able to check the passage of amoebae into the hepatic veins and so to the pulmonary circulation'. Cases of this type are very rare. Ten such cases are recorded in the literature by Lautman, Manson-Bahr and Ramond (Karunaratne, 1940). Manson-Bahr (1940) states that in this condition 'the entamoebae reach the lung by direct embolism from the gut wall. Having gained the pulmonary



circulation they form consolidated nodules, which later break down into small abscesses'.

D. E. S., male, aged 28 years, was admitted to the General Hospital on 5th December, 1941, with pain in the left chest and continued fever of 15 days' duration. Pain radiated to the left shoulder blade. He suffered from dysentery two months ago. On examination he was fairly well nourished. Temperature was 90°F. and pulse 100 per minute. There was slight displacement of the heart to the right. There were signs of fluid at the left base. The abdomen was soft. The liver and spleen were not palpable, and the liver was not tender. The patient was thought to have a simple left-sided pleural effusion and he was treated symptomatically. The diagnosis of effusion was confirmed by an x-ray. As the lung signs persisted and the temperature continued, it was decided to explore the chest. This was done on the 8th day after admission, i.e., the 23rd day of his illness. The fluid withdrawn was chocolate-coloured and microscopical examination showed red cells, pus cells and a few Charcot-Leyden crystals. There were no organisms, no amœbæ or cysts and on culture the fluid was sterile. The fæces contained both cystic and vegetative forms of *E. histolytica*. A white cell count showed 14,600 leucocytes per c.mm. with 76 per cent polymorphonuclears, 22 per cent lymphocytes and 2 per cent eosinophils. A course of emetine injections (1 grain daily) was commenced. The response was remarkable. The temperature settled down and the lung signs gradually disappeared (*vide* chart).

### Discussion

The physical signs on admission suggested a pleural effusion at the left base. There were no reasonable grounds to suspect an amœbic origin on account of the absence of liver tenderness and negative x-ray findings. The treatment at first was therefore entirely symptomatic. On examination of the fluid after aspiration, the diagnosis of a simple pleural effusion had to be discarded in favour of an effusion secondary to amœbic infection, in spite of the absence of involvement of the liver. The treatment was accordingly changed.

The special features of the pleural fluid which made a diagnosis of amœbic infection possible were as follows:—

1. Chocolate-coloured fluid quite unlike the straw-coloured fluid of simple pleural effusion.
2. The presence of Charcot-Leyden crystals.
3. The absence of organisms and the failure to grow any ordinary media.

The diagnosis was clinched by the examination of fæces which showed both cystic and vegetative forms of *E. histolytica*. The blood examination was of much value as it showed a polymorphonuclear leucocytosis. The therapeutic test, namely, the remarkable response to emetine, leaves no doubt that the effusion was due to amœbic infection and the absence of evidence of liver involvement, together with the fact that the effusion was left-sided indicated that it was a primary infection. The question, as to whether the infection of the pleura is secondary to that of the lung as is usually the case in pulmonary tuberculosis, or whether it is a primary involvement of the pleura, is difficult to answer.

### Acknowledgment

My thanks are due to Drs. J. H. F. Jayasuriya and B. E. Fernando, visiting surgeons of the General Hospital, for permitting me to record these two cases which were admitted under their care.

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## HERPES ZOSTER AND SULPHANILAMIDE

By J. C. BISWAS, L.M.F.

Assistant Medical Officer, South Dum Dum Municipality, Dum Dum

For cutting short the severe pain and the course of herpes zoster, apart from big doses of analgesics, oral administration of sodium iodide, injection of pituitary extract and even ultra-violet radiation therapy have all been tried with little good result. In April 1938, Maplestone and Ghose advocated intradermal injection of tissue-lysate, prepared from the herpetic vesicles, and according to them the treatment was uniformly successful in the forty cases they treated; but so far as my knowledge goes, it has not been possible for general practitioners to try this therapy.

As recorded in the April issue of this *Gazette*, Sarkar, failing to relieve a case of intercostal herpes zoster with conservative treatment, finally resorted to the injection of diphtheria antitoxin and attributed his success to it.

Recently, I treated about a dozen cases of varying severity with sulphanilamides with uniformly good results.

Two case notes are given below:—

*Case 1.*—A Hindu male, aged 40 years, a motor-bus cleaner, came to me on 8th December, 1941, with typical herpetic lesions, mostly on the back, complaining of severe pain all over the affected area. His temperature was 101°F. On another doctor's advice some of the vesicles had been ruptured and he told me that these were giving him increased trouble. I told him to dust the whole affected area with starch and zinc powder and prescribed septanilam tablets, two at a time, morning and evening, and advised him all other precautions regarding diet and general mode of living as for any acute febrile condition. He came to me again on the 10th with much improvement. His temperature went down to normal, the vesicles looked rather dried (none suppurating), his pain also disappeared to a great extent. I advised him to continue the same treatment for a few days more. When he came to me again after

three days, he was perfectly all right and looked very cheerful.

Case 2.—A Hindu boy, aged 8 years, was brought to me on 8th January, 1942, with the characteristic herpetic vesicles mostly below and behind the right axilla. He was running a temperature of about 100°F. and looked rather dull and listless, and sometimes cried restlessly from the pain. He had not been put under any recognized form of treatment. I prescribed urea sulphazide one tablet thrice daily and advised his parents to dust the vesicles with starch and zinc powder several times daily. He was put on liquid diet for a few days. I saw the boy again on the 11th, when I noted the vesicles mostly dried (none suppurated) and temperature and pain both disappeared totally. After continuing the treatment for three days more he came to me for the last time when I found him quite well.

Out of the twelve cases treated, eight were given septanilam and the rest urea sulphazide; all of them responded uniformly.

### A FOREIGN BODY IN THE RECTUM FOR FIFTEEN YEARS ?

By KHAN BAHADUR AHMAD BAKSH, O.B.E., I.S.O.

MAJOR

Senior Surgeon, and Superintendent, Prince of Wales Hospital, Bhopal

GOPAL, male, aged 30 years, came in with retention of urine which he had had for 30 hours. His urine was drawn off with a rubber catheter which went in easily, and he was admitted into the ward of the Prince of Wales Hospital.

Next morning when notes of the case were recorded he mentioned that there was some obstruction in his rectum and that it was like a ball moving up and down.

When further questioned he said that he had swallowed a mango-seed last May and it has not



Fig. 1.

Radiogram of the pelvis shows a fairly large stone in the rectum.

yet come out. His rectum was examined and a foreign body like a golf ball was felt inside. His bladder also was sounded but no stone was felt.

A skiagram was taken; an opacity simulating a big stone in the bladder was detected (figure 1). If this point (swallowing a foreign body) had not been mentioned to the radiologist, he would have diagnosed it as a stone in the bladder.

The foreign body was removed with great difficulty by means of a pair of large size lithotomy forceps; it presented the appearance of uric acid calculi to the naked eye (figure 2). Its weight is 58 grammes, length

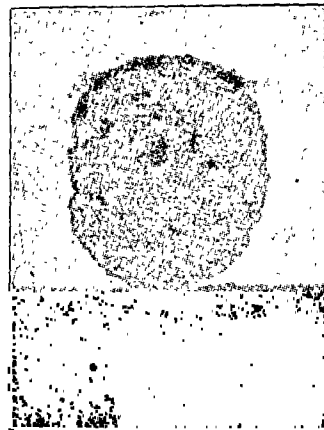


Fig. 2.

2½ inches, breadth 1½ inches and circumference 5½ inches.

After the foreign body was removed the patient was very pleased and he volunteered the true statement saying that when he was about 15 years old he had swallowed the mango-seed and since then it has been lying in his rectum and he was having a motion daily either by pushing it with his finger or with a piece of stick. He further said that due to shame he would not mention this to any one.

The points of interest in this case are :—

- (1) A mango-seed passed throughout the alimentary canal.
- (2) It never gave rise to any symptoms of obstruction of the bowel.
- (3) It caused retention of urine only once; for this he came to the hospital.
- (4) It did not produce any inflammation or ulceration of the rectum though it was lodged there for nearly 15 years, but there appeared to be a pouch on the posterior aspect of the anal canal.

### SCURVY TREATED WITH TOMATO JUICE

By JOHN A. LEWIS, M.B. (Lond.), M.R.C.S. (Eng.)  
and

P. C. DUTT, L.M.F.

Achabam Tea Estate, Upper Assam

THE following case of scurvy which rapidly cleared up on the administration of tomato juice may prove of interest :—

An Assamese girl, aged 8 years, the eighth child in her family, first came under observation in February with a history of weakness and lack of energy for some time previously. For the previous 2 or 3 days the little girl had suffered from bleeding from the nose

and gums, and a rash had appeared over the whole body.

On investigating the family diet, it was found that in spite of the cold weather when fruit and green vegetables are plentiful in the district, the child's main diet consisted of rice, unrelieved by any of the protective foods.

Examination revealed a well-nourished little girl, lying quietly on her back, in a listless manner; there were generalized petechiæ over the whole body, especially the back and lower limbs; and here and there on the trunk and limbs there were several large ecchymoses. The gums were swollen, spongy and easily bled, and there was marked sub-gingival hæmorrhage. No sub-periosteal hæmorrhages were found. There was a moderate degree of anæmia; the blood count was not done, but the hæmoglobin was about 60 per cent. No macroscopic blood was found in urine.

The listless apathetic attitude, history of weakness and loss of energy, and bleeding spongy gums and ecchymoses pointed to the diagnosis of scurvy. Tomato juice was given in massive doses: 8 to 12 ounces were given daily, no other treatment being given. The result was rapid and successful, the child being quite normal in 6 days from the commencement of the tomato juice.

### VON RITTER'S DISEASE (DERMATITIS EXFOLIATIVA NEONATORUM) TREATED WITH SULPHAPYRIDINE

By JOHN A. LEWIS, M.B. (Lond.), M.R.C.S. (Eng.)  
and

B. SAHA, L.M.F. (Calcutta)  
*Achabam Tea Estate, Upper Assam*

THE following case of an unusual disease is reported, in view of the successful result with sulphapyridine treatment:—

A female infant, aged 5 days, and otherwise healthy, the daughter of an Assam tea garden 'babu', first came under observation with a few localized papules on the abdomen, axilla, inner surface of the arms and thighs, and neck. Slight infection in these papules resulted in the formation of pustules, the majority of which cleared up rapidly with simple treatment.

A week or so later, a generalized eruption occurred, commencing on the scalp and quickly spreading over the whole body: the rash consisted of large erythematous patches, which rapidly became confluent and passed through the stages of vesicles, pustules and later copious and extensive desquamation.

Coincidentally with this eruption, somewhat severe constitutional disturbances occurred with moderate pyrexia (100°F. to 101°F.) and marked gastro-intestinal upset with intractable vomiting. The infant became dehydrated and seriously ill, not responding to any of the usual measures which included the administration of fluid parenterally.

At this stage, the case seemed to fit well into the clinical picture described as occurring in von Ritter's disease by Mumford (1937); this disease is usually considered to be a variant of pemphigus neonatorum and is stated to show a mortality of 50 per cent. Ryan and Goldman (1940) described a case successfully treated with sulphapyridine, and it was decided to try the drug in this case.

A dose of 0.5 gramme was given by mouth crushed in milk, and subsequently 0.15 gramme every four hours to a total of 3 grammes. The effect was striking, the infant improving from

the first dose, and after 4 days the rash had nearly cleared and the vomiting disappeared. Ordinary measures were carried on while sulphapyridine was being administered.

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### A CASE OF PAROXYSMAL HÆMATURIA DUE TO MALARIA

By PROBODH CHANDRA DUTT, L.M.F.

*Assistant Medical Officer, Tinkong Tea Estate, Assam*

MALARIAL hæmaturia is not commonly met with even in endemic places, and the following case note will therefore be of some clinical interest:—

*History.*—The patient, a male child of four years, was brought by his mother on 15th November, 1941, with complaints of fever and bloody urine since the morning. On enquiry it was found that the child had a similar attack, lasting for a day or so, about two weeks previously.

*On admission.*—The child looked pale and slightly anæmic. Temperature 101.2°F. Abdomen soft and no tenderness. Spleen slightly enlarged. Liver not palpable. There was free passage of urine which was bright red in colour and intimately mixed with blood. Nothing abnormal noted in heart and lungs. Examination of blood film revealed moderate infection of benign tertian and malignant tertian malaria parasites, ring forms. Urine report showed considerable amount of albumin, red cells in abundance and a few epithelial casts.

*Treatment.*—He was given quinine 2 grains, half an hour after an alkaline mixture, three times a day, calcium lactate grains 5 twice daily and glucose water drinks.

Next morning the temperature came down to normal with marked improvement of the colour of urine which cleared up soon.

On 24th November blood was again examined but no parasites were found. Urine report showed no abnormality. Alkaline and quinine mixtures were now given twice daily.

On 26th the child had another febrile paroxysm—(temperature 100.8°F.) attended with hæmaturia. No malaria parasite found in the blood. Urine contained albumin, red cells and a few epithelial and granular casts.

The temperature came down to normal on the following morning with a slight rise (99°F.) in the afternoon. Urine was just smoky.

On 28th temperature normal, urine almost cleared. In addition to alkaline and quinine mixtures, he was then put on plasmoquine simplex 0.005 gm. twice daily after food for six days.

Since then the child had no other paroxysm. Urine was examined subsequently and no evidence of kidney disease was found.

My thanks are due to my chief, Dr. J. A. Lewis, for his valuable advice and kind permission to report this case.

[*Note.*—The urine in blackwater fever may contain scanty red cells, but in view of the large number seen in the urine of this patient, the possibility of malarial nephritis should be considered.—Editor, I. M. G.]

# Indian Medical Gazette

DECEMBER

## THE TREATMENT OF BACILLARY DYSENTERY

THE field of tropical medicine was without question the kindergarten of chemotherapy, and it was a little disappointing that when the science came of age and widened its scope, with the introduction of the sulphonamides, so few tropical infections appeared to be influenced by these drugs. It is true that sulphonylamide was advocated in sprue, but the benefit derived was not dramatic; similarly good results were claimed with these drugs in brucellosis, but again recent results have been disappointing, and the treatment of malaria by sulphapyridine was nothing more than a matter of academic interest.

Sulphapyridine soon after its introduction threatened to become a panacea, and it is very surprising that it was some years before attention was drawn to its action in acute bacillary dysentery; in fact, the writer's first reactions to a paper that was sent for publication in this journal were frankly sceptical. Experience in chronic bacillary dysentery had, he knew, been disappointing, and it seemed improbable that someone had not noticed the good results in acute bacillary dysentery much earlier, if they really occurred. However, evidence that sulphapyridine was capable of producing dramatic results in this infection rapidly accumulated, and more than one tea-estate medical officer has expressed the opinion that the drug has revolutionised the treatment of bowel diseases on tea estates and altered the whole aspect of practice in these districts.

For the drug to be effective a full therapeutic dose should be given and the treatment maintained until all symptoms have subsided—with due respect to the dangers of too prolonged administrations of this drug. If it is not given in sufficiently large doses, it is all absorbed in the upper part of the bowel and none reaches the seat of the trouble; and it has been suggested that if some really satisfactory method of preventing its absorption in the stomach and upper bowel could be adopted, the drug might be more effective.

Meanwhile, however, new compounds have been introduced, and Marshall's sulphanilyl-guanidine promises to prove an effective drug in bowel diseases. The particular value of this

drug lies in the fact that it is absorbed very slowly and even when large doses are given the concentration in the blood does not rise very high. Locally, it is entirely non-irritating and it appears to have a specific, though possibly indirect, action on pathogenic intestinal micro-organisms. The early reports from America suggested that it was very effective in diarrhoea and dysentery in children, and also in adults. Trial quantities were sent to Egypt for use amongst the British troops there, and glowing accounts of its effect in the severest forms of bacillary dysentery have been received. More recently, generous samples of the drug have been sent to India and the first indications are that it is equally efficacious against our local strains of dysentery organism, and further that it may prove a valuable adjuvant in the treatment of cholera.

The drug must be given in adequate doses and its failure in some physicians' hands can be attributed to the failure to appreciate this fact. The dose advocated is 0.1 gramme per kilogramme of body-weight of patient for the first doses and 0.05 gramme per kilogramme for subsequent doses which should be given every four hours until the stools are reduced to 3 or 4 a day, when the dosage can be reduced to 0.05 gramme per kilogramme every 8 hours. This means that an average man (European) of 70 kilogrammes will receive 7 grammes for the first dose and 3.5 grammes for subsequent doses, and the average total dosage in a severe case of dysentery will be well over 100 grammes. This is a very large amount and the cost will not be inconsiderable. The actual taking of this quantity presents no difficulties as it is added to water or milk, stirred up, and taken as an emulsion; it seldom, if ever, causes vomiting.

It is of interest that this drug has been advocated, and is, we are told, being used fairly extensively in Calcutta, as a treatment for typhoid. Drugs do surprising things and, whilst we would hesitate to condemn its use in this infection, we should require very strong evidence to convince us of its efficacy, especially in the minute doses in which it is usually given, for its whole value lies in its low absorption rate, and typhoid fever is essentially a septicæmia.

Another similar drug that is showing promise is succinyl-sulphathiazole. This also is absorbed slowly and depends on its local action in the large bowel. In *in-vitro* experiments, we believe, this drug was more effective than sulphanilyl-guanidine, and early clinical trials suggest that it is at least as effective.

It seems possible that the treatment of bacillary dysentery, which in the past has never been very satisfactory, is entering a new and more promising era.

## Medical News

### DRUGS TECHNICAL ADVISORY BOARD MEETING

THE first meeting of the Drugs Technical Advisory Board (constituted under the Drugs Act, 1940) was held in New Delhi on Monday, 2nd November, under the chairmanship of Lieut.-General Sir Gordon Jolly, K.C.I.E., K.H.P., I.M.S., Director-General of the Indian Medical Service and Chairman of the Board.



Fig. 1.—General Jolly addressing the meeting.

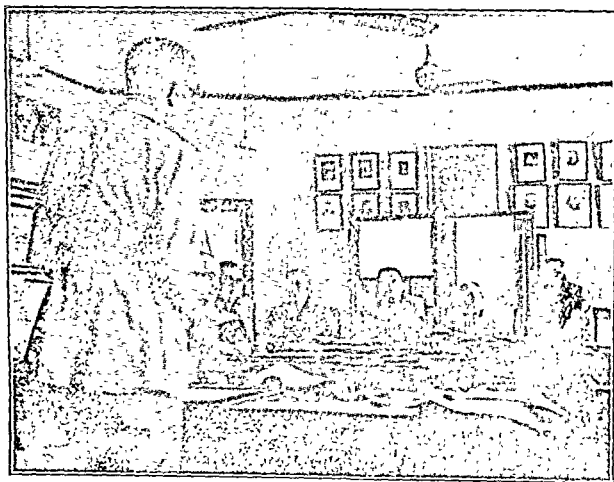


Fig. 2.—Left to right : General Jolly; Dr. Dunnicliff, Chief Chemist, Central Revenues; Major-General Sir John Taylor, Director, Central Research Institute; Dr. S. Rajagopal Naidu, Chemical Examiner to Madras Government; Dr. B. B. Dikshit, Haffkine Institute, Bombay (representative of Indian Research Fund Association); Dr. Anil Kumar Sen (Central Council of Indian Medical Association) and Professor Bires

Chandra Guha, Professor of Applied Chemistry, University College, Calcutta (representative of Indian Chemical Society).

### X-RAY AND INDUSTRY

THE Institute of Physics has just held a conference at the Cavendish Laboratory, Cambridge, on x-rays in industry, to celebrate the thirtieth anniversary of the discovery by Laue of the diffraction of x-rays by crystals. The president of the Conference was Sir Lawrence Bragg, who, with his father, the late Sir William Bragg, showed how to use x-ray diffraction to analyse the structure of crystals. As nearly all solid bodies are crystalline, their methods have led to the creation of a new branch of science, which is of great industrial as well as scientific importance.

The industrial scientist can discover with the help of x-rays the size of particles in substances he is handling, their arrangement in space, and the elasticity of substances. He can use them as a help in discovering the constituents from which his substances are made. He can learn about the hardness of steel, the effects of stretching in rubber, the elasticity of wool, the composition of alloys, and a hundred other properties of industrial importance.

Three hundred industrial and academic scientists joined in the Conference, and they have decided, in view of its great success, to make such a meeting an annual feature of scientific life in Great Britain.

### FACTS ABOUT FOOD FOR SCHOOL CHILDREN

AN attempt to put into simple language important facts about food and diet which the Indian high school pupil should know has been made in a 20-page bulletin 'Food and Diet' prepared in the Nutrition Research Laboratories of the Indian Research Fund Association at Coonoor. The bulletin, primarily intended for use in schools, has been written in simple language avoiding difficult technical terms.

The purpose of the bulletin is expressed in the following observations of Dr. W. R. Aykroyd, Director of the Laboratories, in his preface :

'There is one subject about which all children should learn something, namely, health. In India there is a great deal of ill-health and disease which could be prevented if people understood more about their causes and were determined to remove them. The kind of food we eat has a great influence on our health and much ill-health and disease are due to eating the wrong sort of diet. This Bulletin deals with this part of the subject of health, which is of great importance in India.'

The booklet aims at teaching children about the practical side of dietetics. Thus, while a great deal has been written about vitamins, most of it is of little instructive value to ordinary people. A little knowledge of the more important vitamins is very useful to children. Various points are illustrated by anecdotes, such as the story of how Captain Cook kept his crews free from scurvy.

The purpose of food, what it contains, the rôles of vitamins and mineral salts, the value of milk and various cereals, the importance of cooking and regular meals, and the evils that result from badly balanced and poor diets are explained and the conclusions are summarized in thirteen 'Facts to Remember'.

It is hoped that the booklet will be translated into various Indian languages for use in schools throughout India. Adult students may find its perusal well worth while as the improvement of the diet of the average Indian depends largely on education in dietetics and is a matter of the greatest importance, especially in wartime.

The Bulletin may be obtained from the Manager of Publications, Civil Lines, Delhi, and from other sellers of Government publications at annas three per copy.

## Public Health Section

### PUBLIC HEALTH ORGANIZATION

#### V. THE PUBLIC HEALTH ASPECT OF MALARIA CONTROL

By G. COVELL, M.D., D.P.H., D.T.M. & H.  
BRIGADIER, I.M.S.

(Director, Malaria Institute of India)

IN his introductory paper to this series of articles, Jacocks (1942) made the following statement: 'In view of the importance of malaria in causing ill health it would be unwise for any public health department in any province in India not to have a malaria division directed by a well-trained and experienced officer'.

This principle was recognized as early as 1909, when the Imperial Malaria Conference convened at Simla passed a resolution urging the creation of local provincial organizations to work in consultation with a central committee to be appointed by the Government of India. Subsequently, a provincial malaria committee was actually formed in each province and one of its members was delegated to attend a meeting of the central committee each year. In almost every province there was appointed an officer trained in malaria research, whose function was to carry out investigations which would lead to the institution of preventive measures in his province. During the period immediately following the conference numerous valuable investigations were carried out, notably by Christophers, Bentley, Fry, Graham, Kenrick, Adie, Perry, Gill, T. S. Ross, Horne and Hodgson.

The central body originally consisted of a scientific committee, which suggested lines of investigation and drew up schedules specifying the data most urgently required. The Central Malaria Bureau, to accommodate collections of mosquitoes and a special reference library, was founded at Kasauli in 1909, and courses of instruction in malariology for medical officers were held from 1910 to 1914, first at Amritsar and afterwards at Delhi.

The war of 1914-18 had a disastrous effect on this organization, owing to the fact that individuals of the calibre and status previously available could no longer be spared for anti-malaria work. Malaria officers were still employed in some provinces, but they did not reach the high standard set by their predecessors, and with some notable exceptions such work as was undertaken was relatively unimportant.

During the post-war period a number of malaria inquiries were set on foot by the Indian Research Fund Association; but as the years went by, it became increasingly evident that a permanent organization, both central and provincial in nature, was urgently needed to carry out co-ordinated investigations in regard to the prevention of malaria in India.

At the annual Conference of Medical Research Workers of 1925 the following resolution was passed: 'The conference is impressed with the great need of a permanent organization for carrying out continuous and adequate investigation in regard to the prevention of malaria in India. It also wishes to call attention to the necessity of adequate provincial malaria organizations working in collaboration with the central organization and considers that the constitution of such organization (*which should include at least one effective malaria worker*) ought to receive urgent and early attention by local governments'.

A central malaria organization, with a director, assistant director, entomologist, two research workers, and an appropriate subordinate staff came into being in 1927. A malaria engineer was subsequently added to the cadre. This organization was known as the Malaria Survey of India until 1938, when its designation was changed to that of the Malaria Institute of India. Its functions are as follows:—

1. To be fully informed upon all malaria problems. To advise Government on all issues relative to malaria in India.

2. To initiate inquiries and investigations on malaria. To carry out such inquiries as government may for any reason require. To assist provincial organizations in the carrying out of such inquiries as may be undertaken by them, providing such assistance as desired and even, in certain cases when thought necessary, to lend officers temporarily from the staff to work under local governments.

3. To undertake systematic research in due course into all the basic facts underlying malaria transmission, prevalence and prevention, such as the study of mosquitoes, systematic and bionomical, types of malaria parasites, transmission power of different species of Anopheles, mechanism of infection including the study of endemic and epidemic phenomena, etc. Gradually to complete and organize knowledge on these subjects and to arrange for the making of such knowledge available for practical application, or such other uses as may be desirable.

4. To carry out epidemiological investigations—mapping of endemicity, study of hyperendemic and healthy areas, study of malaria statistics on modern lines—and generally to elucidate the underlying principles of malaria prevalence in India.

5. To advise upon and assist in carrying out of antimalaria measures. To study these scientifically and to judge and elucidate their results.

6. To undertake clinical work on malaria, including treatment. To study serum reactions and allied aids to diagnosis and understanding



the disease. To study relapse problems, effects of new drugs, etc.

7. To assist affiliated researches (e.g., kala-azar, filariasis, sandfly fever, dengue, *Stegomyia* work) by identification of material, provision of trained staff and subordinate personnel.

8. To teach and train officers and others in practical malaria work.

9. To publish scientific results, useful guides, bulletins, etc.

10. To keep alive interest in malaria study and prevention and to see that such interest wherever present is nursed and assisted.

In subsequent years a number of further resolutions were passed by the annual conferences of medical research workers, urging the formation of provincial malaria organizations in provinces where none was provided, and the strengthening of those already in existence.

In most of the provinces in India there exists a malaria organization of some kind, but its composition often leaves much to be desired. In some cases there is a malaria officer with no staff, whilst in others the staff provided is inadequate and insufficiently paid.

The one great lesson which has been learnt as regards the prosecution of antimalaria measures during the last fifty years is that spasmodic attempts at control are doomed to failure. Grants of money have been made to finance schemes of rural malaria control in India over limited periods, and this money has been largely wasted, simply because adequate organizations for expending it to the best advantage did not exist. Staff previously untrained in the special technique of malaria investigations had to be recruited and the only individuals available were men who had either held no previous posts or who for one reason or another were out of employment. Since their services were required only for a limited period, they were faced with the certain prospect of being once more thrown out of employment when the funds had been spent. It is not to be wondered at that they took little interest in the work and were mainly preoccupied in looking out for posts which would render their future more secure. This led to constant changes in personnel and little good was accomplished.

It cannot be too strongly stressed that the first and most important requirement for provincial malaria organizations is *continuity of effort* and this can only be attained if the terms offered are sufficiently attractive, so that the officers employed may be content to remain in their present appointments and not be continually on the lookout for more lucrative posts. The officer-in-charge of the department should be given a status and salary at least equal to those of an assistant director of public health. In certain provinces (e.g., Bengal, Bombay and the United Provinces) this is actually the case. Adequate salaries should also be paid to the remainder of the staff, which will naturally vary in number with the size of the province and the

local importance of malaria as a public health problem. The staff recently sanctioned for Bombay Presidency includes :—

One A. D. P. H. (Malariology),  
One Entomologist,  
Two Medical Officers,  
Four Subordinate Medical Service Officers,  
Two Clerks,  
Two Laboratory Assistants,  
Eight Insect Collectors.

This staff is to be regarded as the minimum requirement for any province in India. It is intended that the Bombay Presidency malaria organization will later be expanded, its numbers having been limited in the first place by the difficulty of obtaining sufficient trained personnel at the present time.

The second requirement is that the staff employed must receive adequate training, such as is provided by the intensive courses held at the Malaria Institute of India. At the present time, these courses are necessarily restricted to members of the Defence Services, but it is intended to resume the training of civilian health officers as soon as immediate war-time requirements have been met.

The functions of the provincial malaria organizations should be :—

1. To advise the local government on all questions regarding malaria problems in the province.

2. To carry out epidemiological investigations in malarious areas and to formulate control programmes based on these investigations.

3. To direct and supervise such control measures for at least one year after they have been put into operation, and to continue investigations during that period.

4. To promote the education of government officials and of the general public in the basic principles of malaria prevention, by means of posters, pamphlets, cinema demonstrations and other forms of propaganda.

It is particularly important that the activities of the malaria department should not be restricted merely to the investigation of malaria conditions and the formulation of a control programme. It should actually initiate the control measures and should continue to carry out observations until they have been established on a proper basis. It frequently happens that considerable modifications have to be made in a malaria control programme after it has been in operation for some while, in the light of the experience thus gained. In fact, finality is never reached in antimalaria work. There is always room for further improvement, and the good malaria officer is constantly on the lookout for methods by which he can reduce still further the possibilities of transmission of the disease in the area under his control.

It is now generally recognized that no anti-malaria scheme can have any chance of success without continuous supervision by an officer.

who has received special training. This officer must be provided with an adequate salary, and in the interest of economy the scheme must be planned in such a way that supervision may be exercised where it will benefit the greatest number of people. In this connection the question of transportation becomes of fundamental importance and one of the most important factors for the furtherance of antimalaria work in the tropics is the development of road and rail communications, whereby the cost of supervision can be spread over larger areas (Covell, 1941). Antimalaria schemes should be initiated in rural municipalities in the first place. There is usually fairly good road communication in the immediate neighbourhood of such centres, so that the work may be extended into the nearby villages without much difficulty. These townships, which would normally be the headquarters of talukas, etc., with their surrounding villages, would act as foci whose activities would be linked up one with another in course of time.

The control of malaria in towns and cities and among the personnel employed by industrial concerns such as tea, coffee or rubber estates, mines, railways, etc., by modern methods has become comparatively easy. Under such conditions, large numbers of persons are congregated in relatively small areas. The interference with industry caused by outbreaks of malaria among labour forces and superior personnel renders it easy to draw up a balance sheet showing the cost of the disease to the community and demonstrating that the expenditure necessary for controlling the disease represents a paying proposition. There are many instances in India where the incidence of malaria has been greatly reduced under such circumstances by the application of antilarval measures.

The control of rural malaria, however, presents a very different problem, not only in India but in all countries where the disease is a public health problem of importance. The population is scattered over immense areas, and there are usually innumerable water collections which afford breeding places for malaria-carrying mosquitoes. The prevention of mosquito breeding under such circumstances becomes a financial impossibility and the control of rural malaria by antilarval measures is out of the question. The only measure which has been applied on a wide scale in this country to mitigate rural malaria is the provision of an adequate supply of antimalarial drugs, either by free distribution or by the sale of treatments at a price which brings them within reach of the average villager. No one will dispute that the provision of adequate treatment should supplement antimalaria measures, but as was pointed out by Jacocks (*loc. cit.*) none of the communicable diseases at present in existence has ever been controlled by such a method.

Observations carried out in India during the last seven years have raised the hope that in the

spray-killing of adult mosquitoes with pyrethrum insecticides we have at last a weapon which, when its full possibilities have been developed, will prove effective for combating rural, as well as urban and industrial, malaria. The principle involved is that a mosquito can only transmit malaria if, after feeding on an infected person, it has succeeded in living for a period of not less than ten days. If it can be destroyed within this period, it cannot convey the disease. In other words, the object of the method is not to reduce the number of mosquitoes in any great measure, but to cut short the life of the average mosquito to such an extent that it cannot become infective. A sure proof of its efficacy is provided by the results of dissections of mosquitoes in sprayed and unsprayed villages. If the method has been properly and systematically applied, no infective mosquitoes are found in the sprayed villages whilst in the unsprayed villages the infectivity rate is unchanged.

Two great advantages of the method are that (i) it is the only antimalaria measure which is universally popular, and (ii) it is the only measure which can exert an *immediate* effect on an epidemic. In addition to mosquitoes, many other insect pests such as flies, fleas, bugs, cockroaches, sandflies and eye-flies, are also destroyed.

Spray-killing of adult mosquitoes was brought into use in India in Delhi in 1936, first in quarters occupied by Government personnel and subsequently in villages (Covell, Mulligan, and Afridi, 1938). It has been practised with success in certain villages in Madras Presidency (Russell and Knipe, 1939; 1940; 1941) and in tea plantations in Assam (Viswanathan, 1941; 1942). It is now regularly employed in many parts of India for the protection of personnel, such as police, railway, forest or other Government employees, and labour forces on estates, mills and other industrial enterprises, and in the writer's opinion it represents the greatest advance which has been made in malaria control measures in recent years.

As regards costs, even under present circumstances, it is usually considerably cheaper than any antilarval measure. It has been demonstrated that pyrethrum of high quality can be produced in many parts of India (e.g., Kodaikanal, Nilgiris, the Punjab Hills, the N.W.F.P., and Mayurbhanj and Kashmir States) and it is certain that within a few years there will be an ample supply of home-grown pyrethrum to meet the country's needs. Experiments are also being carried out with a view to substituting water for kerosene as a diluent for the spray, and thus greatly reducing the cost of the method. These have given encouraging results and there is every hope that an effective mosquitocide will eventually be made available at a price that will render it possible to provide a measure of protection against the ravages of malaria for rural populations throughout the

country. The most urgent need at present is the extension of pyrethrum cultivation in India, and this should receive active encouragement from local governments in all provinces where agricultural and climatic conditions are suitable, notably in Madras Presidency.

Another matter of importance is the instruction of government officials and employers of labour and especially of engineers of all branches in the elementary principles of antimalarial sanitation. Courses in malariology for engineers were instituted by the Health Organization of the League of Nations in 1939 and in the following year by the Government of India in Delhi. At present these are held in abeyance, but it is hoped to resume them as soon as circumstances permit.

### Summary

1. An essential preliminary to the successful control of malaria in India is the formation of an adequately staffed permanent malaria organization in each province, the activities of which should be linked with those of the central organization of the Government of India.

2. The status and salary of the officers-in-charge of such permanent organizations should be at least those of an assistant director of public health. Adequate salaries must also be provided for the remainder of the personnel, in order to secure continuity of service.

3. The functions of the central and provincial malaria organizations are laid down and discussed.

4. The importance of the method of spray-killing adult mosquitoes with pyrethrum insecticides as a weapon for combating rural malaria in India is stressed.

5. There is urgent need for the extension of pyrethrum cultivation in India and this should receive active encouragement from local governments in all provinces where agricultural and climatic conditions are suitable.

6. Stress is also laid on the importance of instructing government officials and employers of labour and especially engineers in the elementary principles of antimalarial sanitation.

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## ON AGRICULTURAL MALARIA AND ITS CONTROL WITH SPECIAL REFERENCE TO SOUTH INDIA\*

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### Introduction

THIS paper presents some observations and reflections on the subject of the interrelationship between agriculture and malaria. It is based primarily on six years of intensive malaria surveys and research studies, in which medical, biological, and engineering, as well as agricultural aspects of the subject were explored by a group of specialists in South India.

Quoting Hehir (1927), 'compared with agriculture, the other industries of India, though they play a useful part in the economic life of the country, are of minor importance. Agriculture is, and always will be, the great field of industrial activity, for upon it the welfare and prosperity of the large masses of India depend'. As pointed out by Sinton (1939) it is the small farmer and the agricultural labourer who have to bear the brunt of the onslaught of malaria. This author stated that about 40 to 50 times as many 'fever' deaths occur in rural areas as in urban, and that the influence of malaria upon agriculture is 'one of the most important economic problems of India'.

There are many ways in which agriculture and malaria impinge one on the other. There is, first, the effect of malaria in retarding agricultural development. As an instance, Christophers (1924) noted the broad belt of many hundreds of square miles, called the Terai, along the foot of the Himalayas where the soil is fertile but where malaria for centuries has been, and is to-day, an effective barrier to agriculture. Again Perry (1914) called attention to the Jeypore Hill Tracts where rainfall is abundant and soil rich but where only aboriginal hill tribes are able to survive the depredations of malaria. To-day, even as this author reported in 1914, these areas are 'crying out for development', but malaria blocks the way. Many similar areas could be named.

Secondly, malaria has not only prevented development of agricultural lands but it has actually forced the abandonment of large tracts, bringing depopulation and economic disaster to extensive areas. For instance, Banerjee (1916) wrote about malaria in Bengal in these words. 'It would be no exaggeration to say that some of the fairest parts of my loved province have

\* This paper is based on observations made in the course of malaria investigations in South India under the auspices of the International Health Division of the Rockefeller Foundation, co-operating with the Madras Health Department, and the Pasteur Institute of Southern India.

been decimated by this terrible scourge.... I have with my own eyes seen villages once the abode of health, happiness and plenty, now a crumbling mass of dilapidated structures, overgrown with jungle.... Other areas in India, abandoned because of malaria, could be named.

In the third place, there is the question of malaria on tea, coffee, rubber, pepper, and cardamom plantations in Assam, Bengal, Madras, and other areas, where this disease has exacted a very high tax in money and life but where one can report very considerable progress in control. This is due to the initiative of the planters, who have been aided by the Malaria Institute of India and the Ross Institute of the London School of Tropical Medicine and Hygiene, following the magnificent demonstration of estate malaria control, originated and inspired by Sir Malcolm Watson in Malaya.

Fourthly, one must cite the retarding effect of malaria on the preservation, development, and exploitation of forest resources of India. Passing note may be made of the epidemics of malaria which have often followed the opening up of a ravine where the removal of shade has allowed a vector species, like *A. minimus* or *fluviatilis*, to flourish.

In the fifth place there is the urgent problem of irrigation malaria. This has been discussed by Russell (1938) and by Sinton (1939) and will have consideration below. In some areas the water-logging which has been so detrimental to agriculture has at the same time created a malaria menace.

In the sixth place, there is the subject of man-made malaria due to mosquito vectors breeding in collections of water which the farmer or irrigation engineer creates or maintains in a state suitable for the mosquito. This phase will be discussed below (Russell, 1941).

In the seventh place, there is the fact that in many localities where the farmer has established a sort of balance with endemic malaria and succeeds in cultivating the soil, he must pay a yearly 'malaria tax' in the form of money for folk-medicines or quinine, doctors or quacks, priests or sacrificial animals. This point will be mentioned below (Russell and Menon, 1942).

Finally, in some areas of South India there is the important phenomenon, seen in a few areas in other parts of the world, that the more intensive and extensive the agricultural practice, the less the intensity and extent of malaria.

The following discussion relates primarily to South India, with reference to certain specific crops which are associated with malaria and including the last four points made above. It also considers what can be done to cope with this vital problem of agricultural malaria.

#### South Indian crops

The principal crops in Madras Presidency are rice, millets (e.g., *cholam*, *cumbu*, *ragi*,

*korra*), pulses (e.g., Bengal gram, red gram), oil seeds (e.g., ground-nuts, gingelly, castor, coconut), tobacco, tea, coffee, rubber, cinchona, turmeric, cotton, potatoes (in the Nilgiris), spices (e.g., chillies, peppers, ginger, cardamom), sugar-cane, fire-wood (*casuarina*), betel-vine, and fruit (bananas, citrus, mango, papaya, and areca nut). Of these, only rice, sugar-cane betel-vine, banana, areca nut, turmeric, and *casuarina* have been observed by the authors to be actual sources of malaria vector mosquitoes by virtue of methods of cultivation. Others, such as tea, coffee, cardamom, and rubber, are associated with natural foothill malaria because of the type of locality in which they grow best. Still others, such as cotton and the millets, are grown in such naturally malarious flat areas as one sees in the Bellary district.

Rice cultivation is the principal source of malaria due to agricultural methods but, paradoxically, the great rice growing areas of the Tanjore, Godaveri, and Krishna deltas, and the narrow rice-growing belt along the western sea-coast, are not malarious. This point will be discussed below.

A sugar-cane field is in alternate ridges and furrows, the crops standing on ridges. Water is allowed into the furrows at intervals of eight to ten days. No appreciable stagnation of water is normally allowed in the furrows, as sugar-cane does not thrive under such conditions. In ill-drained soils, there may be some stagnation affording breeding conditions for mosquitoes.

Irrigation of banana gardens is through a series of trenches along the length and breadth of the field, which presents a chess board pattern. The plants are on mounds which absorb moisture from the trenches. In the Cauvery and Godaveri deltas, as elsewhere on heavy soils, such a system of irrigation is in vogue, and the trenches are never dry except in midsummer. In the Cauvery delta millions of *A. culicifacies* breed in such trenches.

Irrigation of a turmeric crop is more or less like that of a banana crop. In Trichinopoly, Karur, and Erode taluks, turmeric fields are traversed by many trenches which carry water most of the year, enabling mosquitoes to breed in thousands.

In a betel-vine garden, land is thrown into alternate trenches and ridges. The vines are planted in two rows on the ridges, and between the rows of vines are grown support plants like 'agathi' (*Sesbania grandiflora*), which also afford the necessary shade. The trenches invariably carry water which the ryot splashes on the vines. These trenches are far more numerous than in a banana garden and mosquitoes breed the year round.

In wet lands where soils are heavy, ryots grow such crops as bananas, betel-vines, and turmeric in such a way that the root zones do not get water-logged. This is achieved by cutting a series of trenches which carry water. The soil around the plants absorbs moisture from the

trenches. This system keeps the soil well drained but mosquitoes, including potential vectors of malaria, find ideal breeding conditions in the trenches.

#### *Man-made malaria*

Farmers, whatever their crop, produce a disconcerting amount of man-made malaria in certain areas because of the facilities they give to vector mosquitoes in collections of water in waste-land, wet fallow fields, ill-kept channels, uncovered irrigation wells, and miscellaneous back-yard pits. So, too, public works engineers, by heedless removal of earth and by untidy or defective irrigation construction and maintenance, create or permit many dangerous collections of water in roadside and canal-side pits, waste land, and sundry depressions. The failure of farmers, engineers, and public servants to appreciate the extent to which they actively inflict malaria on others is one of the social obstacles to the control of malaria in many lands, and especially in areas of South India (Russell, 1941).

#### *Rice culture and malaria*

The subject of rice culture and malaria has long been controversial because of a failure to analyse it into its component parts. It is basically very simple. If rice culture in an area gives rise to a sufficient number of mosquitoes of a species known to transmit malaria then in that area rice culture is malariogenic. On the contrary, if the output of malaria vectors from the rice fields of an area is so low that the required critical density for malaria transmission is not maintained, or if, as is often the case, the mosquitoes arising from rice fields are not malaria vectors, then that area will be non-malarious.

Both types of rice culture in reference to malaria are seen in South India. The fact that the greatest rice growing areas are not malarious has already been noted. On the other hand in Pattukkottai taluk, adjacent to the Tanjore delta, rice fields certainly play a significant part in maintaining endemic malaria by virtue of their large output of *A. culicifacies*, the vector.

The following types of situation may prevail as regards rice culture and malaria:—

1. Rice fields and their channels may be completely harmless because a vector anopheline is never found in them (e.g., in the Philippines, as recorded by Holt and Russell, 1932).

2. Rice fields and channels may be only potentially dangerous because, although a vector mosquito is occasionally present, it is not found in sufficient density to propagate malaria (e.g., the Tanjore delta as mentioned below. See also reference to occasional *A. minimus* in rice fields, by Rice and Savage, 1932).

3. Rice fields may be harmless but their feeder side channels dangerous (e.g., in some areas of Ceylon, as noted by Barnes and Russell, 1925; and in the Nilgiris, South India, as noted by Russell and Jacob, 1942).

4. Rice fields may be dangerous only for a part of the season (e.g., in Pattukkottai, only until the rice is about a foot high, as noted by Russell and H. R. Rao (1940). (See Manson and Ramsay, 1932, regarding *A. minimus* in fallow rice fields near coolie lines.)

5. Rice fields may be dangerous throughout the growing season (e.g., in parts of China, as noted by Robertson and Chang, 1937).

Therefore, each rice field area must be judged on its own characters as to its malariogenic possibilities and as to the measures required to curb these. In some areas, as in parts of Malaya and the Philippines, one is even justified in advocating the extension of wet rice culture as a malaria control measure; in other areas, as in the vicinity of Savannah, Georgia (U.S.A.), all wet rice culture has been forbidden as a malaria control measure. In still other areas, as in the Pattukkottai area, rice culture as now practised is a source of malaria. It would be much less malarious, possibly not at all, were more intensive cultivation and more tidy water practice in vogue.

It may be of interest to discuss some characters of Pattukkottai rice fields in reference to malaria, as they have been observed over a period of five years.

#### *Fallow rice fields*

The main rice season in Pattukkottai taluk begins in the middle of July, when water is made available for seed-bed preparation. These seed-beds form about a tenth of the entire rice area. Upon arrival of water, the ryot is expected to busy himself immediately, wetting those fields he will use as seed-beds and preparing them for sowing. This work should take about 10 days. Ordinarily, the ryot reacts in a leisurely fashion. Water floods his seed-beds and other fields as well but he is not ready with his plough and bullocks. He often allows an interval of two to three weeks to elapse before beginning work in his seed-beds. The effects of this lag is very significant as regards the output of the malaria vector *A. culicifacies* because the most dangerous stage of the fallow field is when it is wet and unploughed (Russell and H. R. Rao, 1940).

The nurseries develop for 45 days before being pulled out for transplantation. During this time water has been flooding fallow fields everywhere. The ryot is too busy with his seed-beds to do other field work, such as carting manure and preliminary ploughing. He expects to plough a fortnight before transplanting his crop, but his fields remain wet, unploughed, and fallow for over five weeks, and during this period *A. culicifacies* is produced in extraordinarily large numbers.

In another paper, the anophelines of rice fields and the estimated output of adults have been discussed (Russell and H. R. Rao, 1940). *A. culicifacies* has its highest density in unploughed,

wet, fallow fields. Subsequent cultural operations decrease its density. The ryot's tardiness and unwillingness to follow a well-defined agricultural time-table contribute towards an enormously high *culicifacies* output.

#### Nurseries and growing rice fields

Nurseries produce *A. culicifacies*; so also do growing fields before the rice crop is a foot tall. Fortunately, *A. culicifacies* is not found in rice fields when the plants are more than a foot tall, due apparently to obstruction to ovipositing (Russell and Rao, T. R.). The total output of *A. culicifacies* from these two habitats is not inconsiderable, and in view of the area, even low densities have practical importance and require consideration in any control scheme.

#### Field channels

Field channels, whether for watering rice fields or for other purposes, breed *A. culicifacies* practically throughout the rice season. In the general scheme of water distribution in Pattukkottai, the field channel is the responsibility of the ryot. He locates and maintains it. Often he has more total channel length than is necessary for efficient irrigation of his fields, and to that extent *culicifacies* numbers are increased. The channels are very often tortuous, thereby increasing breeding edge out of all proportion to optimum length. The ryot does not keep these edges tidy, not realizing, of course, that each water pocket means increased numbers of *A. culicifacies*. He pays absolutely no attention to channel gradient and frequently breaches bunds to flood adjacent land. When he takes water from the channel, he cuts open bunds indiscriminately, creating more *culicifacies* breeding conditions in the process.

Thus because of (i) long (and needless) periods when fields are wet but fallow; (ii) ill-conceived and poorly maintained channels; (iii) a natural tendency for *A. culicifacies* to breed under such conditions as well as in planted rice fields until the stalks are a foot high, the cultivation of this crop is a source of malaria in the area. But, as will be shown below, there is good reason to believe that were the first two factors eliminated the amount of breeding in planted rice fields during the early stages of growth would not by itself be sufficient to maintain malaria.

#### Rice culture and malaria in Nilgiris-Wynaad

The vector in the foothills of the Nilgiris-Wynaad area is *A. fluviatilis* which is found in largest numbers in small hill streams and in rice field and other irrigation or drainage channels (Covell and Harbhagwan, 1939; Russell and Jacob, 1942). In these districts, generally between elevations of 1,000 and 4,000 feet, the small channels of running water which supply or drain rice fields are definitely malariogenic. Not only do such channels menace nearby villages but frequently they tend to nullify expensive control programmes directed against the natural

streams of adjacent estates. Usually rice fields are owned by small farmers and not by estates.

Contrary to the Pattukkottai situation, it does not appear that this source of malaria incidental to Wynaad-Nilgiris rice culture can justly be attributed to imperfect agricultural practice. Nor is it clear how it can be controlled to best advantage. Possibly it can be neglected, provided spray-killing of adult mosquitoes is practised, as noted below. However, attempts have been made to employ herbage packing, sluicing, and shading in order to inhibit breeding. The last two are suitable measures if under proper supervision, such as may prevail on an estate. Elsewhere in rural areas good supervision is almost never seen.

#### Other foothill agricultural malaria

Both in Gudalur and in Kallar, of the Nilgiris District, for the cultivation of bananas and (in Kallar) of areca (betel) nut palms, there are irrigation systems which are malariogenic because of the breeding of *A. fluviatilis* in the supply of drainage channels, or in the depressions between rows of plants. Such sources of malaria could easily be eliminated by proper regulation of the water, providing for short drying periods.

But by far the greatest amount of agricultural malaria in the foothills has been that affecting the tea, coffee, and rubber estates. It has originated not in artificial channels, but in natural foothill streams (Measham, 1939; and especially Covell and Harbhagwan, 1939). Not infrequently the practice of clearing preparatory to planting has been responsible for opening up of ravines, so that dense jungle growth has given way to grass and open plantings along the stream edges. This has induced *A. fluviatilis* to extend into streams not attractive to it when heavily shaded, and so has presented a man-made addition to the already serious natural malaria problem.

As stated above, much progress has been made by planting communities in the control of malaria, formerly by lavish use of oil but later by such methods as sluicing and shading, and recently, by spray-killing with pyrethrum extracts. Careful siting of labourers has also been a favourable factor in some areas. But smaller and poorly organized estates, particularly if Indian-owned, are still all too frequently hotbeds of malaria.

#### Casuarina cultivation and malaria

There is a narrow strip of sandy sea coast from Madras City northwards for about 120 miles, where *Casuarina equisetifolia* Forst. is extensively cultivated for firewood. This tree grows readily in sandy soil, if watered regularly for two or three years, until it has put its roots into the subsoil water, which in this area is fairly near the surface (two to six feet, generally). The cheapest and easiest way of obtaining water for the young trees is by scooping out shallow wells from which water in earthen pots is carried by labourers. As reported by Russell and Jacob



(1939a) these casuarina pits or wells are prolific sources of *A. culicifacies*, the vector. By themselves they constitute a source of agricultural malaria which attains an average endemicity of over 60 per cent, measured by spleen index.

This intense malaria is nearly 100 per cent man-made and agricultural in origin, and has seriously retarded the development of such localities as Ennore.

Several times pit-filling schemes have been instituted by Government but the pits have always been redug because there is no cheaper or easier way of obtaining the essential irrigation water. So, too, pumps and special wells have been tried out and have also come up against that law of human nature, that man tends always to satisfy his needs with the least possible exertion. The authors cited above, on the basis of extended experiments, believed that this casuarina pit malaria could be controlled very cheaply by the use of *Gambusia* fishes (Russell and Jacob, 1939b).

### *Irrigation malaria*

It has long been recognized that an irrigation system that brings vital supplies of water to a previously dry area may also bring malaria. This subject has already been discussed in detail by Russell (1938) and need only be recapitulated here.

As observed in Pattukkottai, there were certain specific ways in which irrigation produced malaria, in every case by facilitating the development of the malaria-carrying mosquito, *A. culicifacies*. These points were summarized by Russell (1938) somewhat as follows:—

1. *Defective sluice gates*, which permit water to flow when and where not required thus forming dangerous pools and unwanted channels.

2. *Seeping canal banks*.

3. *Borrow-pits*.

4. *Defective distributing chambers*, which send water in directions not indicated by requirements, so that mosquito-breeding pools are formed. Such chambers may actually block the flow and cause ponding.

5. *Excessive supply of water*, causing a great deal of mosquito breeding directly along canal banks and, indirectly, by pools and irregular channels.

6. *Improper delivery of water*, for example, into a roadway or roadside ditch, or into an open uncultivated field, or a village square, there to form mosquito-breeding places.

7. *Improperly maintained canal banks*.

8. *Improperly maintained canal beds*, which slow down the current so that it permits more breeding, or so that many mosquito-breeding pools appear at the end of the irrigation season.

9. *Absence of any planned or controlled system of field channels*.

10. *Insufficient number of bridges* across canals, thus isolating villagers from main roads so that they breach the banks, causing ponding.

1. *Absence of drainage canals*. This invariably creates a menace not only to the health of the community but to the very land itself. The evils of water-logging should not require emphasis.

12. *General untidiness*. Here a pipe is missing, there a bridge was forgotten; here is a leaky gate, there a defective distributing chamber; here a small section of canal was never dug, there two or three channels do the work of one; here a bathing ghat should have been built, there cattle protection is required. In view of the fact that these 'little things' are producing malaria, it is no proper answer to say that in time they will be corrected.

The following are some general mosquito-producing effects of an irrigation system, especially as seen in Pattukkottai:—

1. *A dry taluk becomes a wet one during the irrigation season*.

2. *Fallow fields remain wet for a longer period*.

3. *Rivers and tanks carry more water during the wet season and are empty for a shorter time during the dry season than formerly*.

4. *The subsoil water level rises because of irrigation without drainage*.

5. *Unplanned streams and channels become numerous*.

6. *Ditches are full of water throughout the irrigation season*.

7. *Borrow-pits fill with irrigation water and remain full during the season and for a varying period thereafter*.

The point was made in the paper cited (Russell, 1938) that it was not irrigation *per se* in Pattukkottai but *untidy and defective irrigation* that was a source of malaria. *A. culicifacies* is a weak vector with an infection index of only 0.1 per cent (Russell and Rao, 1940) and it has a high preference for bovine blood (Russell and Rao). It is only when this species is prevalent in very large numbers that it is an effective vector, and it is only when an irrigation system is grossly at fault that it can produce *A. culicifacies* in sufficient abundance to menace the health of a community. Finally, it is only in the absence of collaboration between Health and Public Works Departments that such disastrous irrigation malaria could arise. Pattukkottai taluk was non-malarious until 1933-34 when the irrigation system was opened. The average malaria spleen index in the taluk is now (November 1941) 56.5 per cent, and the parasite index 49.9 per cent.

### *Brick-pits and borrow-pits*

In the villages, houses are mud-walled. The flooring is made of earth, and plastered with cow dung. Cattle sheds have raised earthen floors and granaries are earth-lined. All this earth the ryot obtains by digging borrow-pits. So it is very common to see village sites studded with such pits. Due to the rise of subsoil water,

these pits are flooded and become prolific sources of *A. culicifacies*.

The ryot also has a practice of lowering the level of his fields for easier irrigation. This he achieves by digging pits in the fields and putting the excavated soil on the bunds. At a later date he fills the pits as he levels his field. These pits often remain a long time before being levelled. They collect water which is attractive to *A. culicifacies*.

#### Waste land

Waste, i.e., untilled, lands collect irrigation water and breed enormous numbers of *A. culicifacies*. In most cases such land is arable and if intelligently reclaimed and cultivated would no longer be malariogenic. This procedure is discussed below.

#### Cost of malaria to the ryot

It is not always realized that malaria is a source of actual expense to a ryot, aside from the many indirect ways in which this disease contracts his income. There is need for many more malario-economic surveys such as that reported by Russel and Menon (1942).

In that survey it was determined in the Pattukkottai village of Tuvarangurichchi that the ryots were spending an average of Rs. 2-8 *per capita* per year to treat malarial fevers. Of course, not much of this money went to physicians but it was paid out for the kind of treatment available to or desired by the ryots, e.g. for quacks, priests, folk-medicines, candles, and sacrificial animals. In addition the lost wages due to absence from work because of malarial fevers were conservatively estimated at Re. 1-6 *per capita*. Here was a yearly loss of Rs. 3-14 *per capita*, due to malaria. Yet, as noted below, the disease could be completely controlled in this village for about As. 4 *per capita* per year.

It seems likely that these data are representative of, or are less than, the *per capita* cost of malaria to ryots in hundreds of thousands of small malarious villages throughout India. It can be deduced that malaria is a considerable direct financial burden to the ryots, whose average *per capita* annual income is probably not over Rs. 45, and in Tuvarangurichchi was only Rs. 35-3 at the time of the survey.

#### Control of agricultural malaria

Malaria can be controlled by (a) attacking the larvæ of malaria vector mosquitoes; (b) attacking the adult mosquitoes; (c) combining both measures. We do not believe that it can be controlled by distributing cinchona products or any other malaria remedy now available. Certainly, experiments over a half-century or more do not indicate that malaria control by drugs is possible, although, of course, no one disputes the need for better and more widely practised malaria therapy to alleviate suffering and to prevent malaria deaths.

In 1936, one of us (Russell, 1936) wrote: 'The simple truth seems to be that to-day, while prophylaxis by standardized methods is feasible in selected areas, there is not available an economical method of malaria prevention for much of rural India'. This pessimistic statement was based on the state of knowledge that existed in 1936 and was certainly true as regards the agricultural malaria of small rural villages. It was partly because of this situation that six years have been devoted to extensive investigations and experiments in methods of control of rural malaria. Now, happily, it has been proved that the above quotation is no longer true. It is now undoubtedly a fact that for much of rural India malaria control is not only feasible but financially profitable. The following sections discuss briefly some of the methods available:—

#### Spray-killing adult mosquitoes

It now seems beyond doubt that the method of malaria control of most promise for rural areas is that of daytime spraying of huts and out-buildings with pyrethrum sprays.

Beginning in 1938, experiments have been carried out each season under direction of the senior authors, with spray-killing of adult mosquitoes in houses and cowsheds, using a pyrethrum-kerosene extract diluted with either more kerosene, or with water. In Kasangadu village, for example, a mixture consisting of 1 part Pyroicide 20 and 19 parts kerosene was sprayed in every house, cowshed, and out-building once a week during the irrigation seasons of 1938, 1939 and 1940, but not in 1941. Since adult *culicifacies* mosquitoes rest in the daytime inside houses, cowsheds, and out-buildings, this measure has been very effective. The spleen rate in Kasangadu in November 1937 was 68 per cent. By November 1938, it had dropped to 24 per cent, in November 1939, it was 15 per cent, and November 1940, it had come to the low rate of 6 per cent, with a parasite rate of .ml. The nearby and similar village of Tuvarangurichchi was not sprayed but was subject to the same spleen tests. Here the spleen rates in November 1937, 1938, 1939 and 1940 were 55, 61, 57 and 58 per cent respectively. In other words, the transmission of malaria was completely halted in Kasangadu, and this was not the result of natural influences but of the spray-killing. The cost of the work in Kasangadu was nearly a rupee *per capita* in 1938 and 1939, but, with improved technique, had dropped to As. 7-2 *per capita* in 1940.

In 1941 Kasangadu was purposely not sprayed. As a result the spleen rate rose to 17.0 per cent and the parasite rate to 15.3 per cent. This illustrates the need for continuity of effort.

Other villages were sprayed in 1940 and 1941. In Modalcheri, for example, an extract from Nilgiris-grown pyrethrum was used. Pyrethrum has been grown in India only during the last few years and this was perhaps the first large scale

field use of an extract of Indian *pyrethrum* in South India. It is much cheaper than imported extracts. In Modalcheri the cost of spraying was only As. 4-7 *per capita*. Here the spleen rate, which was 80 per cent in November 1937, and 82 per cent in 1938, dropped to 28 per cent in November 1940, after only one season's spraying, and to 6.3 per cent in 1941, after two seasons. Villagers welcome spraying, which kills other insects as well as mosquitoes.

During 1941 a successful water-emulsion spray was developed, using a concentrated kerosene extract of Indian grown *pyrethrum* (1 gallon), an emulsifier (sodium lauryl sulphate, 184 grammes), and water (7 gallons). This spray-mixture cost only As. 7-9 per gallon, as contrasted with Pyroicide 20 and kerosene at Rs. 3-1-7 per gallon. It gave excellent results in a Pattukkottai village, causing a reduction in spleen rate from 48 per cent in 1940 to 16 per cent in 1941, after only one season of spraying, and at a total cost of only As. 3 *per capita*.

It is obvious that spray-killing is as useful in South India as it has been shown to be in South Africa, and, by the Malaria Institute of India in Delhi. There are many communities that could afford to pay the annual cost of spray-killing to control malaria. Many others could do so if helped by Government agencies [Russell and Knipe (1939), (1940), (1941); Russell, Knipe and Sitapathy (1943); Russell, Knipe and T. R. Rao (1942)]. For earlier references to spray-killing successes see De Meillon (1936) and Covell *et al.* (1938).

#### *Intermittent irrigation*

Experiments, over a period of four years, with intermittent irrigation or a so-called 'turn system', to control mosquito breeding in rice fields have given as promising results in Pattukkottai taluk as have been reported from Java, Portugal, and elsewhere. The principle of intermittent irrigation as a malaria control measure is the periodical withholding of water just long enough to permit the surface of fields and channels to become sufficiently dry to cause the death of all mosquito larvæ. The sub-surface soil around the rice roots remains moist. In South India it takes a week or a little longer for the eggs of the malaria vector *A. culicifacies* to develop through larval and pupal stages, before the adult emerges. Hence a weekly drying effectively controls breeding of this species.

The experiments with intermittent irrigation have been of two kinds. First, an area of rented land was divided into uniform plots, some of which were irrigated normally, others with 5 wet days, followed by 1, 2, 3, or 4 dry days. This experiment had four seasons and at the end of each the crops of rice and straw were carefully weighed. The results have shown that in the plots from which water was excluded for only one day it was not possible to kill mosquito larvæ because the fields did not become sufficiently dry. Good mosquito control, however,

was seen in the plots kept dry for 2, 3, or 4 days, except in the rainy month of November when the plots did not always become dry. This did not matter as regards *culicifacies* because, as noted elsewhere, this species is not found in local rice fields after the rice is over a foot in height, as it generally is throughout the taluk by mid-October.

Of course, type of soil is an important factor in determining how long a period is required to dry a field. Some soils retain water closely while others are quite porous. In Pattukkottai, where one is dealing with medium sandy loam, 2 to 2½ days' drying seemed sufficient to destroy larvæ. In other areas more time might be required.

There was no significant difference in weight of weeds removed from the plots, whether normally or intermittently irrigated. Further, no significant differences in crop yield were noticed, except during the first season when, due to fungus disease, the yield was a little less in the intermittent plots. Analysis of grain at the Nutrition Research Laboratories in Coonoor showed no differences in nutritive value between the two lots of rice.

In 1940 and 1941, as a second type of experiment, intermittent irrigation was applied to two village areas, Alivalam and Senjayakollai, from the outset of the season until the November rains. Good mosquito control in fields and channels was obtained and no differences in rice crops as compared to other areas could be seen by competent observers. Further testing is required as regards administrative technique. But here seems to be an economically feasible measure of malaria control for Pattukkottai taluk, as well as for other irrigated areas in India (Russell, Knipe and H. R. Rao, 1942).

#### *Malaria control by attacking larvæ of malaria vectors*

Complete elimination of all mosquito breeding places would seem, perhaps, to be ideal, but because of very important social, economic and (in the case of certain tanks) sentimental reasons, such complete elimination, even if limited to the vector species, is neither desirable nor practicable. Whether a given breeding place should be left alone, or be filled or drained, treated with oil or Paris green, or so modified as to make it unsuitable for larvæ, must always be determined by local conditions.

It would seem that, logically, an attack on larvæ in such an area as Pattukkottai taluk should first consist of correcting defects in the irrigation system, preventing wastage of water, filling or draining pits and ditches which serve no purpose. In order to demonstrate methods, costs and effects of such an anti-larva attack, Knipe and Russell (1942) chose an area of seven square miles, comprising the six hamlets of Senjayakollai (pop. 500), Aladikumulai (pop. 550), Enadi (pop. 1,440), Naravallikollai (pop. 400), Surankadu (pop. 300), and Veerakurichchi

(pop. 200). Over 700 large borrow-pits were filled, usually by taking earth from high level fields so that many (35.5) acres of new rice land were brought under cultivation as a by-product of the filling operations. Some 55,000 cubic yards of earth were used as fill. Numerous new field supply channels were formed (66,707 lineal feet of canals excavated or realigned), tight fitting gates (9) were installed at the sluice heads in canals, improved devices for tidy control of water in field channels were installed, fifteen culverts were provided for easy access to fields including two large highway culverts built across a canal, an inverted siphon of an improved design was put under a roadway, and many cart-tracks were put in order. Intermittent irrigation was practised in 1940 and 1941.

*Gambusia* fishes were put into 1,464 wells. These wells were first chlorinated to kill larger fishes which would eat small larva-destroying *Gambusia*. These fishes were very useful in wells but did not establish themselves in tanks, apparently because of predatory fishes. Several tanks were cleaned and deepened. Every one of these measures had a direct relation to mosquito control, but many also formed important means of village reconstruction and so have been of permanent benefit to the people.

The results achieved in reducing the incidence of malaria were good, as shown by the following spleen and parasite rates:—

*Malaria season spleen and parasite rates in villages with experimental larva control*

| Description                                 | 1937             |          | 1941             |          |
|---|------------------|----------|------------------|----------|
|   | PERCENTAGE RATES |          | PERCENTAGE RATES |          |
|   | Spleen           | Parasite | Spleen           | Parasite |
| Senjayakollai                               | 48               | 42       | 4                | Nil      |
| Enadi*                                      | 54               | 50       | 19               | 10       |
| Aladikumalai                                | 56               | 49       | 11               | 3        |
| Contrast village of Pappanadu (no control). | 53               | 43       | 57               | 48       |

\* Control measures in Enadi not effective until latter part of 1940.

Costs of this work in the Senjayakollai area have not been excessive. The total was Rs. 14,841-5-5 which amounts to Rs. 3-4 per acre or Rs. 4-6 *per capita*. During 1941 we provided adequate maintenance, with decreasing spleen rates, at a cost of only As. 2 per acre or As. 1-11 *per capita*, surely not beyond the financial resources of the community. (Knipe and Russell, 1942).

The best method of dealing with borrow-pits is filling. This is expensive and it is a pity that the digging of new borrow-pits under official auspices continues in the taluk almost unchecked. These borrow-pits have been proved

to be a prolific source of *culicifacies* and so of misery and even death to the inhabitants of the taluk. It seems absurd that, often merely to facilitate the measuring of earth removed by contractors, these malaria-generating pits should be tolerated.

In a number of instances, as mentioned above, filling has been accomplished with earth taken from fields too high to be irrigated. The nature of the soil is such that there is not much loss to a field by removing the top-soil and the benefits of irrigation soon make up the deficit. This procedure combines malaria control with agricultural gain and could be widely practised in the taluk.

In some cases, villagers have been cut off from a main road by a canal and so have breached the canal to get their carts across. This has led to the formation of breeding places which have been eliminated by providing suitable culverts.

For control of breeding along canals and channels, experiments with Paris green have been successful, both when applied with an automatic distributor and when sprayed in a watery suspension. When Paris green floats on top of water *Anopheles* larvæ, which feed most of the time at the surface, will eat the poison and are killed within a very short time. In the automatic distributors, Paris green and charcoal powder are kept in hoppers from which the mixture is shaken out by the action of paddle wheels moved by the stream of the canal. Wind and water currents distribute the poison to the sides of the canal where the larvæ feed on it and are destroyed (Knipe and Russell). When sprayers were used, a man walked along the canal banks spraying Paris green suspended in a watery emulsion. Various types of spray pumps were used (Russell, Knipe and T. R. Rao, 1940).

We have had some success in one village with the naturalistic method of using *Wolfia* to exclude mosquito breeding from small tanks and pools. When this plant completely covers the water surface, no larvæ are found. It can be transplanted from pool to pool and grows fairly rapidly.

#### *Malaria control by extending and intensifying cultivation*

Hackett (1937) noted a saying in Italy that 'malaria flees before the plough'. He also quoted Aschenfeldt as having said in 1845, 'Nothing but the greatest wilderness or the most perfect cultivation protects an area from malaria fever'. But Hackett rightly points out that while this may have been the case in some areas it has certainly not been true in others. There are areas where severe malaria persists, apparently uninfluenced, in the face of intensive cultivation of the soil.

There has often been a tendency to consider malaria as a sociological problem to be attacked by such social measures as heightening agricultural or industrial activity, improving diets and

housing. But there is no sound evidence that famine and malnutrition, for example, are direct etiological factors in malaria, in fact such experiments as have been done indicate that a well-nourished individual is fully as susceptible to plasmodia as one who is malnourished. What Hackett (1937, p. 15) calls the American thesis, that malaria is a simple function of anopheline vector density, has never been upset and must be kept in mind. Any measure that tends to destroy the anopheline vector, to lower its density, or to keep it from man, may have prophylactic value. Otherwise, it cannot be classed as malaria control. 'Good housing', for example, has no malaria control value unless it includes screening and proper siting with reference to malaria vectors. It seems clear that as regards the immediate technique of malaria control one must not fail to make direct attacks on the insect vector. Attempts at control malaria by supplying routine social service or more opportunity for industrial and agricultural activity are apt to be futile.

Here, as in the case of the malaria of rice fields, the question is whether or not intensifying and extending cultivation will reduce the numbers of the mosquito vector. If it does, then 'malaria flees before the plough'. If the vector species is not disturbed or is perhaps increased in numbers then malaria has nothing to fear from the plough.

Reference has already been made to the observation that malarious Pattukkottai taluk was contiguous to the great rice-growing non-malarious Tanjore delta, and, of course, the reason for the absence of malaria in the latter area was a matter of great interest. Careful studies were made, comparing four villages near Tiruvadi in the delta and four similar villages in Pattukkottai taluk. These studies included an investigation of the manner of rice culture in each village. It was also necessary to examine minutely hundreds of *culicifacies* mosquitoes collected in each area. Their anatomical characters, their preferences for cow or human blood, their ability to carry malaria, and especially their relative abundance in each area, were observed and evaluated (Russell and T. R. Rao).

These studies proved that the *culicifacies* of the two areas were identical species, morphologically and biologically, with the same habits, and with equal susceptibility to experimental malaria. But the numbers present in the delta were markedly fewer than in the taluk. This was shown over a period of two years by measured collections in houses, cowsheds, and traps. There was no doubt that *culicifacies* mosquitoes were very much more abundant in Pattukkottai taluk than in the delta, and that this fact explained why the former area was malarious and the latter not. It is probable that if *culicifacies* were present in great numbers in the delta there would indeed be malaria there. But with a species like *culicifacies*, of

which only one in a thousand is found infected in the area under observation, very great numbers are required to propagate malaria.

So the next question was, 'Why are *culicifacies* mosquitoes less numerous in the delta, where so much rice is grown by wet cultivation'?

The answer seemed to be in the following points :—

1. The delta area near Tiruvadi was mainly a two-crop area, so that rice fields remained wet fallow only for short periods, prior to transplanting.

2. The delta area had practically no borrow-pits.

3. The delta area had practically no uncultivated low land on which waste irrigation water could stand.

4. The delta area had relatively few small field channels carrying fresh irrigation water.

By contrast,

1. Pattukkottai taluk was mainly a single crop area, so that most rice fields remained wet fallow for a long time, usually from mid-June to late August, at a time when the mosquito population increased rapidly.

2. The taluk had innumerable borrow-pits along the roads and canals.

3. There were many uncultivated low-lying lands in the taluk on which waste irrigation water remained from mid-June to the following February.

4. There were in the taluk enormous numbers of small field channels (called 'field *bodhis*') carrying fresh irrigation water.

Many observations made it clear that fallow fields, borrow-pits, field channels, and waste irrigation water were prolific source of *culicifacies*. It therefore became understandable why *culicifacies* was so much more abundant in the taluk than in the delta, and why, since *culicifacies* was the carrier, malaria was common in the taluk but not in the delta (Russell and T. R. Rao).

On the basis of these observations it appears that in Pattukkottai taluk, malaria would flee before a more efficient plough. The needlessly prolonged period of wet fallow fields, the single instead of double rice crop, the undue length of field channels, and their neglected condition, the wet waste lands, the untidy and defective irrigation, the unprotected irrigation wells—each of these factors contributes to the malaria of Pattukkottai taluk by adding to the numbers of the mosquito vector. All might be corrected by more intensive and more extensive as well as more intelligent agricultural practice.

As noted above, co-operation between various governmental agencies is of vital importance in preventing and controlling agricultural malaria. Not only is it necessary for public works and public health departments to work in unison against mosquitoes but far more co-operation by agricultural departments is required. For instance, when planning or developing an irrigation scheme in a potentially or actually

malarious area, efforts should be made by the agricultural advisers not only to curtail the mosquito output from wet fields but to replace malariogenic crops, such as rice, by less dangerous plantings such as millets or cotton wherever possible.

In order to demonstrate that it is not only a means of reducing the incidence of *A. culicifacies* but also a financially shrewd proposition to turn waste land into cultivation, an area of nine acres was dealt with near Alivalam, in Pattukkottai taluk in 1941-1942. This land had produced nothing but mosquitoes, including *A. culicifacies*, during each irrigation season, when it was either flooded or was the site of seepage water.

Nine rice fields were laid out at a cost of about Rs. 1,350, or Rs. 150 per acre. This land had a value before reclamation of only Rs. 15 per acre. After the rice fields had been laid out the value was, conservatively, Rs. 250 per acre, an immediate gain of Rs. 235, or a net gain of Rs. 85 per acre, over original cost and the expense of reclamation. This represented an immediate profit of Rs. 765 or a little over 50 per cent on the investment of Rs. 1,485. The net return in rice crops the first few years is estimated at Rs. 20 per acre, more thereafter as the land improves. Even at the low figure of Rs. 20 per acre the investment of Rs. 1,485 would yield an annual income of a little over 12 per cent.

Reduction in breeding of *A. culicifacies* was achieved because, instead of breeding unhampered throughout the irrigation season, this species only bred until the rice plants were about a foot high. As noted above, after this stage this species is not found in rice fields.

In other words, in Pattukkottai taluk, and no doubt in many other rural areas in India, it is no longer correct for revenue officials to say that their Government cannot afford to control malaria. The fact is exactly the reverse. A country like India, where the farmers are so poor, and where agriculture is the predominant industry, cannot afford to allow malaria to continue to ravage its countryside, financially as well as physically, when it is known that it costs less to control it than to permit it to remain.

### Summary

This paper notes that India is predominantly an agricultural country and it points out how malaria impinges on agriculture by retarding agricultural development, by forcing the abandonment of fertile areas, by afflicting organized tea, coffee, rubber, and other plantations, by preventing maximum development and exploitation of forest resources, by complicating irrigation systems, by virtue of a great many man-made breeding places created by farmers, by exacting a yearly cash outlay from the already impoverished ryots for what they consider to be treatment, by the fact that in some areas there is an inverse correlation

between amount of malaria and the degree to which cultivation has been extended and intensified.

The relation between rice culture and malaria is discussed and it is pointed out that this relationship depends on the degree to which rice fields and their channels from breeding places for malaria mosquito vectors. Many rice-growing areas in India are non-malarious but in the Pattukkottai area described, rice fields and channels are definitely malariogenic, breeding *A. culicifacies* the vector. In the Nilgiris-Wynaad area, rice field supply and drainage channels are definite sources of the malaria vector, *A. fluviatilis*.

Casuarina-pit malaria, along a coastal strip north of Madras City, is also discussed. Here the shallow wells or pits, dug in the sandy soil to provide a source of water for the young trees, are prolific breeding places of *A. culicifacies*, the vector.

Reference is made to some of the ways in which irrigation, both construction and maintenance, is associated with malaria. There is also a consideration of what malaria costs the ryot in direct money losses. For instance, in one village the ryots were spending Rs. 2-8 *per capita* per year to treat malaria, losing in addition Re. 1-6 in wages *per capita* per year.

The control of agricultural malaria is considered and reference made to the fact that, whereas in 1936 it appeared that no method had been shown to be financially feasible for small rural communities in India, it is now possible to recommend spray-killing with pyrethrum extracts, at a cost of no more than a quarter of a rupee *per capita* per year, in many small villages. So, too, intermittent irrigation on a 5-wet, 2-dry day basis, seems feasible in some areas.

Control by antilarval measures is also cited and it is pointed out that, although this involves a certain initial outlay, maintenance can be provided for less than two annas *per capita* per year.

Finally, reference is made to the possibility of malaria control in the Pattukkottai area by intensifying and extending cultivation, and the reasons for believing this are explained.

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## Current Topics

### The Treatment of Congenital Syphilis

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(Abstracted from the *Practitioner*, Vol. CXLVIII, May 1942, p. 280)

In any discussion of the treatment of congenital syphilis, special prominence must always be given to the statement that this is a disease which should seldom or never require treatment, for the simple reason that means are available to prevent its appearance. It cannot be too strongly emphasized therefore that prophylaxis is the correct method of approach to congenital syphilis. This means the timely and thorough cure of the acquired variety of the mischief in prospective parents, and especially of the mother during pregnancy. It is only in this way that 100 per cent of the children can be saved.

The uterus is a poor nidus for the spirochæte, so that the infection tends to remain latent. However, with the advent of conception and the development of the placental tissues, there is produced a favourable soil for the proliferation of the contagium vivum. This has been amply confirmed by the examination of the placenta of the syphilitic mother. Invariably spirochætes are detected in the placenta of the mother of syphilitic offspring, and always in greatest abundance in the decidual portion of the placenta. It is from this focus in the placenta that the foetus becomes infected and, although the migration of the spirochæte may take place at any stage during pregnancy, it would seem to occur generally during the latter half of gestation and perhaps most frequently during parturition.

#### ANTENATAL TREATMENT

It is generally admitted that if antisyphilitic treatment of the mother with salvarsan is begun before the fifth month of pregnancy, infection of the foetus is almost certainly avoided. However, good results may be obtained if the treatment is not instituted until even a later date, no doubt because, as already remarked, infection of the foetus is often delayed until during the process of parturition. In the author's experience, for instance, a healthy non-syphilitic child has always been born when treatment was begun before the beginning of the eighth month of pregnancy.

Antenatal treatment with salvarsan was found to be an advance on the older method of treatment with mercury and potassium iodide. By the administration of these latter drugs to the syphilitic mother during pregnancy, sometimes a healthy non-syphilitic child would be born, but if they were not again employed during the succeeding pregnancy, syphilitic pregnancy was almost certain to result. On the other hand, with treatment with salvarsan and mercury during pregnancy, not only was a healthy infant the rule, but without any further treatment the mother would continue to bear in her succeeding pregnancies healthy non-syphilitic children.

*Technique.*—The author's practice has been to treat the pregnant woman with neosalvarsan and mercurial inunction, beginning as early as possible, usually about the second month of gestation, and repeating the injection of 0.3 gm. of the arsenical compound at weekly or fortnightly intervals for at least eight times, or until the Wassermann reaction is negative. The women have been little upset by the treatment, apart from some headache and sickness during the twenty-four hours succeeding the injections. The mercurial inunction should be continued throughout the pregnancy.

#### TREATMENT OF THE CHILD

Should, however, the disease not have been prevented, either because antenatal treatment had not been instituted, or because it had been delayed unduly, there is no cause for despondency, for at no time has the cure of syphilis in the new born and young child been possible in such a large proportion of cases and, furthermore, with such little discomfort to the patient and his parents.

Salvarsan has the serious disadvantage that it has to be administered intravenously, always a difficult procedure in the child.

No. 594 of Ehrlich, which chemically is 3-acetyl-amino-4-hydroxyphenylarsonic acid, is generally known as acetarsone, and has been put on the market with the trade name of spirocid in Germany and of stovarsol in France. It contains 27.1 to 27.4 per cent of arsenic in comparison with 19 per cent in arsphenamine or salvarsan. It is a white, almost tasteless powder, slightly soluble in milk and water. The drug has been employed not only for the cure of the actively syphilitic child, but also for the potentially syphilitic child

as well, i.e., the new born of an untreated or insufficiently treated mother but not presenting any symptoms of the disease beyond a positive Wassermann reaction.

Practically all have found it superior in its effect to any other drug, and especially in the early manifestations of congenital syphilis.

**Action of acetarsone.**—Most authors speak of the rapidity with which the early manifestations of congenital syphilis improve during acetarsone therapy. The rash is found to disappear in from one to four weeks, snuffles in from four to six weeks, splenic enlargement in six weeks, and bone lesions radiologically appear completely healed within ten weeks. Naturally, less dramatic results are obtained in the case of the later manifestations of the disease as of course is true also of other methods of treatment. Not a few authors, however, record good results in the later visceral and osseous manifestations, and some, e.g., Bratusch-Marrain, have shown that acetarsone is also of value in cerebral syphilis. All authors remark on the improvement in the nutrition of the child which takes place during the course of treatment with acetarsone.

**Toxic effects** seldom occur and those that have been encountered have as a rule been mild and evanescent in nature. The most frequent toxic manifestations recorded have been slight looseness of the motions and moderate fever, but occasionally dermatitis, which in one or two isolated instances has proved fatal, has been observed. Withholding of the drug for a day or so is, as a rule, effective in causing toxic symptoms to disappear, when the treatment, starting again with diminished doses, may be safely resumed. Toxic effects have usually been observed in ill and wasted infants, so that special watchfulness is necessary in such patients.

**Dosage.**—In order to gauge the susceptibility of the individual child, all writers recommend that at first the drug should be administered in relatively small doses, which, however, are gradually increased until the optimum is being given. Although a few workers administer the drug daily without intermission during the whole course of a so-called 'cure', which extends to forty or fifty days, some advise a periodic intermission to give time for its complete elimination and a consequent diminution in liability to toxic effects. Thus it is given only on every alternate day or every fourth day, or again it is given for seven or ten consecutive days which are followed by a free interval of four days. In all schemes of treatment a free period of four to six weeks after the completion of one course, or so-called 'cure', is advised.

After the completion of one course of the treatment, or so-called 'cure', the result of the serological tests (Wassermann and Kahn or Meinicke) is noted. If the serological test is still positive, a second course is instituted after a rest period of four to six weeks, and if the test still remains positive, further courses are undertaken at four-weekly intervals until a negative reaction is obtained. If, however, after the first course, the serological test is negative, the child is kept under observation for a period of one year and the tests are repeated at three-monthly intervals in order to be sure that the cure has been complete.

#### SCHEME OF TREATMENT WITH ACETARSONE (AFTER MÜLLER)

The technique followed and found effective is that devised by Erich Müller but reinforced by daily mercurial inunction. This scheme has with one exception given good results, especially in children under one year of age. The single exception was an infant who had symptoms of congenital obliteration of the bile ducts. In all the other cases the cutaneous lesions rapidly disappeared and a negative Wassermann reaction was obtained at the conclusion of the first course of treatment. But to make certain that a cure had been established, a second course of treatment, with of course mercurial inunction, was always practised. In no case there were any toxic effects other than a temporary albuminuria.

The course of treatment extends over fourteen weeks divided into seven periods of two weeks each. For the first ten days of each period acetarsone is given daily and then intermitted for four days. After each period the urine should be examined for albumin to see if there has resulted any damage to the kidneys. If albumin is present, the next period should not begin until all albumin has disappeared.

Two scales, (a) and (b), of daily dosage are used. If the child is under 10 pounds in weight, or is very ill, the smaller dosage (a) is employed, and if the child is over 10 pounds in weight and vigorous, the larger scale of doses (b) is followed. The daily dose is divided into several portions, e.g., four, and given in a little water before or after the feeds.

Parents should be warned to stop the treatment on the appearance of any fever, vomiting, diarrhoea or rash, and not to resume its administration until the family practitioner has been consulted.

Acetarsone is prepared by Bayer Products, Ltd., under the trade name spirocid, and by Messrs. May and Baker under the name of stovarsol, and is supplied in 4 grains (0.25 gm.) tablets by both firms.

#### DETAILS OF DOSAGE

- |           |   |
|-----------|---|
| Period 1. | 1st and 2nd weeks.<br>10 days' acetarsone (spirocid or stovarsol),<br>(a) $\frac{1}{2}$ tablet (each tablet contains<br>4 grains or 0.25 gm.) and (b) 1 tablet<br>daily.<br>4 days' interval. |
| Period 2. | 3rd and 4th weeks.<br>10 days' acetarsone, (a) 1 tablet and<br>(b) $1\frac{1}{2}$ tablets daily.<br>4 days' interval.   |
| Period 3. | 5th and 6th weeks.<br>10 days' acetarsone, (a) $1\frac{1}{2}$ tablets, and<br>(b) 2 tablets daily.<br>4 days' interval.   |
| Period 4. | 7th and 8th weeks.<br>10 days' acetarsone, (a) 2 tablets and<br>(b) 3 tablets daily.<br>4 days' interval.   |
| Period 5. | 9th and 10th weeks.<br>10 days' acetarsone, (a) 3 tablets and<br>(b) 4 tablets daily.<br>4 days' interval.  |
| Period 6. | 11th and 12th weeks.<br>10 days' acetarsone, (a) and (b) 4 tablets<br>daily.<br>4 days' interval.   |
| Period 7. | 13th and 14th weeks.<br>10 days' acetarsone, (a) and (b) 4 tablets<br>daily.<br>4 days' interval.   |

#### Treatment of Fresh Compound Fractures and Wounds

By J. C. SCOTT

(Abstracted from the *British Medical Journal*, Vol. I,  
14th February, 1942, p. 209)

IN this paper are presented the personal views of the author who is in charge of the Accident Service at the Radcliffe Infirmary, Oxford.

Some recent publications have indicated that the extreme urgency of the treatment of compound fractures and wounds is still not universally recognized. In the author's opinion, any review of results of treatment which does not include the time interval between injury and treatment in each case is of little value. The only just cause for delay in treatment is the patient's general condition. Adequate resuscitation should be started immediately the patient arrives in hospital. This should include transfusion in every case of severe compound fracture.

The routine adopted in this Accident Service is to start with plasma by drip infusion on admission, with a change to whole blood if more than 2 pints (about

900 cm.<sup>2</sup>) are necessary. Early splintage is very important and emergency splintage should be carried out without any attempt at reduction. When the patient is ready for operation, the surrounding skin should first be carefully cleaned with soap and water. This cleaning is comparable to the washing of the surgeon's hands. The wound itself should then be washed with soap and water. No irrigation should be carried out. The excision of the wound should begin with the skin and continue in layers to the depth of the wound, all dead or grossly contaminated tissue being removed, where necessary extending the wound by incision. If the wound is more than six hours old, no attempt should be made to suture the skin. Skin sutures should never exert tension on skin edges. Wounds that are left open are dressed with fine mesh dry gauze, and an unpadded plaster is applied. No non-absorbent padding should ever be used in the neighbourhood of the wound, as this interferes with drainage. Counter-drainage should be established as required. Reduction of the fractures is carried out by the accepted method of manual or skeletal traction on the Zimmer machine. Sulphanilamide is sometimes used locally in wounds, although there is as yet no conclusive evidence of its value.

Anti-tetanic serum is administered as a routine. The prophylactic value of gas gangrene anti-toxin is not yet established but it should be used when available. The author's personal view is that in adequate doses it is of considerable value in the treatment of gas gangrene. Prophylactic oral administration of sulphonamides is not recommended, and it is suggested that these drugs have a place only when wound infection is present and the identity of the responsible organisms is known. There is no definite evidence that x-rays have a prophylactic value against gas gangrene.

Out of 31 patients with severe compound fractures of the extremities reported in this paper, the temperature rose above 99°F. (37.2°C.) in only 3. One of these had multiple injuries and bilateral compound fractures of the patellæ, excised and sutured elsewhere, and the right knee became infected. The second case, a severe compound fracture of the tibia and fibula, developed basal pneumonia subsequent to fractured ribs. The third case had a *Staphylococcus aureus* infection of the wound, which responded well to treatment. The average stay in hospital for all cases was seventeen days. There was a complaint of unpleasant odour from the plaster in only one case, a compound fractured femur with extensive skin loss. The bacterial flora in the wounds with and without local application of sulphanilamide is under investigation.

### Intraperitoneal Sulphapyridine in Acute Abdominal Conditions

By R. H. GARDINER

(Abstracted from the *Lancet*, Vol. I, 14th February, 1942, p. 195)

It has recently been reported by workers at the Middlesex Hospital, London, that intraperitoneal administration of sulphanilamide in rabbits with the peritoneal cavity deliberately contaminated by the caecal contents, prevented the development of peritonitis and reduced the inflammatory process following resection of the gut.

The present author was led by this work to use intraperitoneal sulphapyridine in 15 cases of appendicitis. Several of the appendices were found to be gangrenous at operation, and all patients had purulent fluid present in the abdominal cavity, with varying grades of peritonitis, which in 2 cases was general. All cases in this series were considered by the author to require drainage of the abdominal cavity, and the abdominal wound would normally also have been drained if chemotherapy had not been employed.

In addition, 2 cases of resection of gangrenous small intestine (in one case due to adhesions and in the other to strangulated inguinal hernia) and 2 cases of

perforation of the sigmoid colon (in one due to diverticulitis and in the other to sigmoidoscopy) were treated with intraperitoneal sulphapyridine.

At the end of each operation, but before suturing, 10 g. of sulphapyridine was mixed with 4 ounces (about 120 cm.<sup>3</sup>) of saline solution to make a fine suspension. By means of a 10 cm.<sup>3</sup> record syringe some of the suspension was injected into the peritoneal cavity around the operation area and a further quantity into the pelvis. Before the insertion of the last peritoneal stitches, another injection of the suspension was made into the peritoneal cavity, which was then closed. The remainder was injected down the drainage tube, which was then clipped. The powdery residue remaining was applied to the wound edges and the abdominal wall was closed.

The results of this treatment appeared to be promising, and in all the appendicitis cases except one (a woman of 75), the abdominal wounds were soundly united by the 10th day. Instead of the anticipated purulent discharge, a thin almost serous fluid was seen. In most cases the drainage tube was removed on or before the 5th day after operation. The average length of time spent in bed was 11 to 12 days, and patients were usually discharged on the 14th day. The 2 cases of perforation of the sigmoid colon and 1 of the cases of resection of the small intestine, recovered. The patient operated upon for strangulated inguinal hernia died of peritonitis.

The author suggests that further trials should be given to this method and that a combination of local and systemic chemotherapy might possibly have advantages. Such trials should include bacteriological examination of the abdominal fluid and determination of the blood concentrations of sulphonamide.

### Treatment of Trichophyton Foot Infections in the Field

By FIRST-LIEUTENANT CLYDE J. RADEMACHER

(Abstracted from the *Military Surgeon*, Vol. 90, April 1942, p. 431)

THE care and treatment of the feet has always been a serious problem in armies. Many solutions, powders, and ointments have been used in the treatment of fungus infections of the feet with results none too satisfactory. In troops, trichophytosis, 'athletes foot', is a common cause of foot ailments, especially in the warmer climates.

In a battalion of 570, 75 cases of trichophytosis were found. These cases ranged in severity from macerated swollen feet with large fissures and crusting, which incapacitated the patient from all work, to a mere scaling with slight fissures between the toes. These were classified as to severity as follows:—

- |   |         |
|---|---------|
| I. Fissures between toes .. ..  | 6 cases |
| II. Mild swelling; maceration between toes .. ..                                | 13 "    |
| III. Moderately severe cases with swelling, maceration and fissures .. ..       | 30 "    |
| IV. Severe cases, incapacitated. Maceration and swelling of toes and feet .. .. | 26 "    |

Treatment: At the start, half of the group were treated with pure sodium sulphathiazole crystals, dusted on the lesions, and half with 50 per cent sulphathiazole in talc dusted on once daily. The results were spectacular. Practically all the cases were markedly improved within forty-eight hours (with one daily treatment). There was no evidence of any difference in the two series except possibly a slight irritation from the pure crystals which are highly alkaline.

Therefore, from seventy-two hours on, one-half of the cases were treated with 50 per cent sulphathiazole in talc, and the other half of the cases with 25 per cent sulphathiazole in talc. The results in the two series were equally good. There is now a commercial product

of 5 per cent sulphathiazole in a bland ointment that has been reported satisfactory.

Care was taken to cover all infected areas with a film of the powder dusted on with an applicator. Observation of progress was made daily during treatment and at intervals of two weeks after treatment was stopped. Criteria of cure was healing of all lesions and the disappearance of adherent skin debris. All cases classified as cured were re-examined two weeks or longer after the last treatment for signs of recurrence.

Results of the six cases in class IV which were given the above treatment are as follows: Three became class I in an average of seven daily treatments. Three cases were apparently entirely cured at the end of one week; two, however, showed recurrence upon examination two weeks later. These undoubtedly were reinfections from shoes and socks. The spectacular part of these cases was that all the men were relieved of discomfort and able to wear their shoes within three or four days of starting treatment. The net result at the end of one month was one case cured and five cases carried on as class I.

Of thirteen cases in class III, nine appeared to be cured at the completion of treatment (7 to 10 days). Eight of these cases had recurred or were reinfected two weeks later. The remaining four cases were resistant and were reclassified as class I. Net result: one case entirely cured; twelve cases much improved and reclassified as class I.

Treatment of the 30 cases in class II treated for an average of 10 days produced the following results. Eleven cases remained cured; five cases recurred and were placed in class I; eleven cases showed improvement but were resistant; three cases were given incomplete treatment because of transfer or other causes beyond our control. Net result: 11 cases cured; 3 lost; and 16 much improved but needing further treatment.

Treatment of 26 in class I in which the longest period of treatment was 10 days resulted in the following: Nine cases were cured; eleven cases were resistant; six cases inadequately treated due to causes beyond control.

It became evident shortly that the 44 cases remaining under treatment were not responding further. Most of these cases were symptomless and therefore difficult to persuade to return for treatment. These 44 cases were all very much alike, characterized by thick scaling and small fissures between the toes. A few had small deep seated bullæ on the feet. These cases were treated with powdered sulphathiazole 10 per cent in 2 per cent salicylic acid ointment. The length of treatment varied from two weeks to a month.

If the 14 cases that were lost are dropped from consideration, 55 or 90 per cent of the remaining 61 cases were cured. Ten per cent are still resistant; all of these are symptomless with the exception of a slight itching and are marked for duty with their companies.

The most spectacular feature of the whole series is the rapid improvement of the severe incapacitated cases which in the past have often needed hospitalization over long periods. A good deal of the disability in these severe cases is due to a secondary invader. This may account for the excellent results in these severe cases.

A simple manner of treatment could be the addition of ten per cent (10%) sulphathiazole to army foot powder used as a dusting powder. Another preparation might be ten per cent (10%) sulphathiazole in salicylic acid ointment, two per cent (2%). Insistence on care of feet and change of socks remains an important part of the treatment of feet.

## Chemotherapy of Acute Bacillary Dysentery

By G. M. LYON, M.D.

(Abstracted from the *Southern Medical Journal*, Vol. XXXV, June 1942, p. 606)

The guanidine analogue of sulphapyridine is known as sulphaguanidine or sulphanilylguanidine.

Attention was first directed to its possible value as a chemotherapeutic agent in intestinal infections by a paper published in September 1940, by Marshall and others.

Since 15th September, 1940, a group of us in a co-operative effort have subjected sulphaguanidine to a rather extensive test in the treatment of acute bacillary dysentery, popularly known in the mining sections as 'bloody flux'.

Our initial effort was to study sulphaguanidine in a small, well-controlled series of carefully selected patients who had the disease in a severe or moderately severe form and in whom treatment was instituted during the first week of fever or diarrhoea.

Our next step was to subject sulphaguanidine to the practical test of routine use in the treatment of the various forms and stages of 'bloody flux' as they were encountered in clinical practice in the offices, homes and hospitals of our mining sections where bacillary dysentery is endemic.

We have records of approximately 300 patients who had 'bloody diarrhoea' and who were treated with sulphaguanidine. Besides having a 'bloody diarrhoea' all of the patients included had such clinical evidences of acute bacillary dysentery as a characteristic history, fever, malaise, blood and pus, or pus and mucus in their stools. A great many had positive stool cultures or characteristic microscopic evidence when the particles of pus from the stools were examined microscopically.

Obviously not all were bacteriologically proven instances of bacillary dysentery. They were, however, all patients having 'bloody flux' and they were typical of the character and incidence of 'bloody flux' as it is observed in the mining and rural mountainous areas in which acute bacillary dysentery continues to be an important endemic disease, affecting particularly, but not by any means exclusively, infants and young children.

In general, the method of administration employed was that originally recommended by Marshall and employed in the clinical study already described. The initial dose was 0.1 gramme per kilogram of body-weight, while the maintenance dose was 0.05 gramme per kilogram of body-weight administered orally every 4 hours until the stools were less than 5 in 24 hours, and then 0.05 gramme per kilogram of body-weight every 8 hours for 48 to 72 hours. Approximately one-third of the patients received the drug every 4 hours for only 3 days, at which time it was discontinued unless the diarrhoea persisted. Special effort was made to insure an adequate urinary output. In general this was well observed. Particular attention was paid to the detection of any untoward effects which might result from the administration of the relatively new chemical.

From these experiences certain impressions are forthcoming. Besides these there are some definite conclusions which may be drawn, and further recommendations which can now be made in regard to the clinical use of the drug.

Sulphaguanidine has proven to be an effective therapeutic agent in the treatment of acute bacillary dysentery. In proper dosage, and when treatment was begun during the first 5 days of illness, recovery almost invariably occurred in 2 to 3 days. In only exceptional instances was it necessary to give the chemical for more than 5 days. When so used sulphaguanidine was almost entirely free from toxic effects. This almost complete freedom from dangers of toxicity is in striking contrast to that of the other sulphonamide compounds, one of which in particular, sulphathiazole, is effective in the treatment of acute bacillary dysentery and which indeed may be more effective than sulphaguanidine in the treatment of those diarrhoeas resulting from parenteral infections, or perhaps in the late or chronic forms of bacillary dysentery.

When chemotherapy was not employed until somewhat later in the disease, results were generally good, but failures on the other hand were encountered somewhat more often than when it was used early in

the disease. When treatment with the drug was instituted between the fifth and the eleventh day, results as a rule were better than after the eleventh day, but not so good as during the first 5 days. It is important to emphasize the desirability of early treatment.

It was found that when there was blood and pus in the stools and when fever was present, even though the treatments were not started early in the disease, the results were nearly always as satisfactory as in the patients treated earlier. Sulphaguanidine had its least beneficial effects when, however, the dysentery bacilli had disappeared, and when there was no blood or pus in the stools and at a time when presumably the activity of the dysentery bacilli had passed and the diarrhoea was that of the plain green watery type, characteristic of the frequently encountered 'post-infection' intestinal indigestion. This could be expected, however, in view of the underlying pathologic state.

One of the outstanding characteristics of bacillary dysentery although it is often overlooked, is that very frequently an impaired ability on the part of the intestinal tract to digest and assimilate food follows the stage of active bacterial infection. This is believed to be the result of the damage produced within the gastro-intestinal tract by the dysentery bacilli, or their toxins. In such cases sulphaguanidine cannot be expected to be a very effective agent, nor can it restore the damaged digestive system to its normal physiologic efficiency. Fortunately such cases were not commonly encountered. This form of 'post-infection' intestinal indigestion was formerly very common among infants and young children, and although to-day less common, its incidence tends to follow that of acute bacillary dysentery. Such a condition can be prevented by the early treatment of bacillary dysentery with sulphaguanidine. Although less common in adults, this sequelæ is not at all an infrequent one.

There is much to recommend the use of sulphathiazole, perhaps even sulphadiazine as well, in those cases where the persisting diarrhoea is the result of secondary bacterial invaders, with or without deep ulceration. Fortunately such conditions were rarely encountered during the period of our study except perhaps in those infections incurred in the neonatal period and in a few instances in which chemotherapy was instituted late in the infection. Occasional instances of apparently simple diarrhoea were encountered which appeared to have no significant bacterial infection, had no blood or pus in the stools, and which, in spite of adequate chemotherapy, more frequently than not presented no successful response to either sulphaguanidine or sulphathiazole. I believe it is quite likely that the diarrhoea in these patients may possibly have occurred because of (1) a previously unrecognized acute bacillary dysentery with the subsequent development of the 'post-infection' intestinal indigestion already described, or (2) a concomitant parenteral infection, or (3) as has been suggested by some, a diarrhoea due to a local or systemic virus infection. Although these patients were not included in the series as patients with bacillary dysentery, they are mentioned because of their interest in connection with our present discussion.

Very frequently what appeared in the beginning to be a simple diarrhoea turned out in 3 to 5 or more days to be a true bacteriologically proven bacillary dysentery. In several instances since the initial phase could not be distinguished from simple diarrhoea sulphaguanidine was not given until later in the disease. In these instances, results fortunately were, as a rule, good.

Sulphaguanidine, in general, was most effective when used in those patients treated soon after onset, who were most ill, and who had blood and pus in their diarrhoeal stools at the time chemotherapy was begun. It was least effective in those in whom treatment was not begun until after the acute bacterial invasion was over, and when the stools were simply green, watery

and without blood or pus and did not contain dysentery bacilli.

Sulphaguanidine has been observed to be effective against all strains of dysentery bacilli. Paradoxical as it is, the chemical has appeared to have the most remarkable effect in the treatment of the toxic Flexner and Shiga strains. Dr. L. C. Hall, of Paintsville, Kentucky, has described strikingly beneficial results in an epidemic caused by the Hiss-Y strain. While its successful use against the Shiga strain has been described by others, we have had only one proven Shiga infection under observation. This was a patient successfully treated by Dr. E. C. Richards at the Holzer Hospital, Gallipolis, Ohio. There is some limited evidence, particularly in the Baltimore experience, to suggest that sulphaguanidine was somewhat less effective against the clinically less toxic Sonne strain than against the Flexner. The former frequently gives rise to a mild afebrile diarrhoea without blood in the stools and often with little pus. Its distribution is more widespread than is generally recognized.

Practically all of the toxic effects which have been observed to occur with the use of the other sulphonamides have also been observed to follow the use of sulphaguanidine. We have, however, seen practically none of them. The toxic effects noted by others were due no doubt to the fact that the drug was given in doses larger than recommended by Marshall and larger than those employed by us, or there was, during the period of active chemotherapy, little attention paid to the importance of the frequency and the character of the stools in relation to the concentration of the drug in the intestinal tract when the stools were infrequent. If the drug is used as recommended originally by Marshall, and if there is meanwhile a proper urinary output, such toxic effects can be almost entirely avoided. An adequate urinary output is always a desideratum in the treatment of acute bacillary dysentery under any circumstances, and it is quite as necessary when employing a chemotherapeutic agent. If treatment with sulphaguanidine is terminated in 5 to 7 days toxic effects are rarely encountered. Toxic effects may be encountered somewhat more frequently in adults. In infants or young children they rarely occur.

Although sulphaguanidine was perhaps somewhat less effective after the first 5 to 10 days' illness, and after the blood and pus in the stools had given way to the plain watery stool which contained no dysentery bacilli, there is sufficient evidence at hand to indicate the desirability of employing sulphaguanidine in all suspected cases of bacillary dysentery, 'flux' or 'infectious diarrhoea' and in many of the apparently simple diarrhoeas which persist for more than 48 hours. It should be given in the amounts previously recommended every 4 hours for 3 to 5 days and thereafter if recovery has not occurred, it may be desirable, if the gravity of the illness warrants it, to give sulphathiazole, or perhaps sulphadiazine, for another 2 to 5 days. In the meantime, strict regard must be paid to the urinary output; for with all of the sulphonamide compounds there is a strict relationship between adequate urinary output and freedom from toxicity. This plus the fact that water tends to be diverted from the kidneys in all diarrhoeal states, must particularly be remembered in the use of sulphathiazole and sulphadiazine in such conditions.

It may be desirable to use sulphathiazole, or sulphadiazine in the place of sulphaguanidine at the onset when obvious or suspected infections appear outside the gastro-intestinal tract. While in such instances this practice may perhaps be more effective, in the few instances in which sulphathiazole was employed later in the disease, no strikingly favourable results were observed by us.

Sulphathiazole, as previously stated, has been shown to be effective in the acute stages of bacillary dysentery. It is also known to be more toxic than sulphaguanidine when used as both are usually employed. Because of this greater tendency of sulphathiazole to produce toxic effects, and because of the great care with which it should be given, it would seem clear that



it should be the drug of secondary choice in the treatment of acute bacillary dysentery in the early stages, while perhaps in the later stages or in the state of 'post-infection' intestinal indigestion, its use may be more strongly indicated. For use in the home, office, dispensary or in industrial practice, sulphathiazole is definitely not as safe as sulphaguanidine, and should not be employed therein as sulphaguanidine may be. Nor it is as safe as sulphaguanidine for use among armed forces in the field. One of the most satisfactory features of sulphaguanidine is the large margin of safety permitted in this respect without the sacrifice of therapeutic efficiency. Of practical importance is the fact that it is quite frequently necessary to treat patients with acute bacillary dysentery without benefit of hospitalization. For them sulphaguanidine is distinctly the drug of choice, for as we have seen when it is so used it is both effective and safe.

In our series of approximately 300 patients, if we exclude 7 deaths occurring within less than 24 hours of instituting chemotherapy, and if we exclude the 25 patients of the neonatal group still under study, only one death occurred among the patients treated with sulphaguanidine, provided treatment was begun during the first 5 days of illness (diarrhoea and fever) and provided they did not have some other important organic disease or infection (bacterial or viral) outside the intestinal tract. Even the one death included cannot rightfully be called a failure. This occurred in a patient of Dr. L. C. Hall, of Paintsville, Kentucky, the patient having hardly recovered from a severe nearly fatal diarrhoeal disease of unknown aetiology, the onset of which had been little more than one month before.

Parenteral infections, whether due to a virus of the influenza type, or to pyogenic bacteria, were observed to exert a detrimental influence on the clinical progress of the patient with bacillary dysentery, whether treated with sulphaguanidine or not, just as they do in other diarrhoeal states. It is not logical to expect parenteral infections to yield to sulphaguanidine therapy. On the other hand, it was observed with surprising frequency that under the influence of the drug the stools did become normal rather promptly and the intestinal tract appeared better able to carry out its work than it would have had the drug not been employed.

In several patients who in all probability had had bacillary dysentery for some days, or even weeks, before treatment was started, although the diarrhoea was checked early, the general clinical condition of the patient continued poor and the ability of the body to absorb and assimilate food continued to be greatly depressed.

In the late stages of acute bacillary dysentery or its sequelae it may be quite impossible to determine just what difficulties are due to a continuation of the primary bacterial invasion, what to active bacterial infection by secondary invaders of the intestinal tract, what to parenteral infection and what damage within the intestinal tract wrought by the primary bacterial invasion. It is generally the latter which results in serious impairment of the normal processes of digestion and assimilation. All of this complicates the problem of appraising the effectiveness of any chemotherapeutic agent in acute bacillary dysentery or other diarrhoeal states. The presence or absence of bacteria is not in itself sufficient evidence for classification, particularly when conclusions are to be drawn as to the effectiveness of a therapeutic agent. The underlying physiologic and pathologic states must be relatively the same if intelligent comparisons are to be permitted.

No persistent states of 'post-infection' intestinal indigestion or chronic intestinal indigestion developed in any of the patients in whom chemotherapy was begun within 5 days of the onset of fever or diarrhoea, although in the neonatal group there may yet develop some exceptions to this statement.

In those receiving the chemical early, there was surprisingly little disturbance of digestion either during the period of active therapy or following recovery. In spite of this, however, it has seemed advisable to employ during the period of active treatment a bland

diet which is likewise moderately restricted in amount. There is some reason, based upon careful observation, to believe that those patients who were on a diet which was high in protein (casein) and which was moderately restricted in amount, presented better and possibly somewhat more prompt recoveries. Cultured lactic acid milk, cottage cheese, Philadelphia cream cheese and custard, when given in moderate amounts, seemed to be the diet of choice. Vitamins in the form of powder were added to the cultured lactic acid milk of a great many of the patients, and may or may not have influenced the recoveries. Their use is logically indicated, although it is probably less important now, that the clinical course can be regularly shortened by early chemotherapy. They are certainly strongly indicated in the illness lasting more than 2 or 3 days.

Sulphaguanidine was most effective during the time when the dysentery bacilli were more active. It was least effective when the activity of those bacteria was absent, and when their residue remained in the form of abnormal physiologic states within the intestinal tract. While the chemical effectively controlled the activity of the bacteria, it did not, by itself, correct damages already produced by the bacteria, or their toxins, once such damage was already established. By controlling the bacterial infection, sulphaguanidine may have enhanced the effectiveness of such measures as adequate fluid intake, glucose intravenously, calcium gluconate, transfusions of serum and whole blood, *et cetera*, enabling them to correct more effectively the attendant chemical disturbance. Sulphaguanidine itself did not, and it should be emphasized, will not overcome acidosis, dehydration, fluid imbalance or electrolyte disturbance. When altered physiologic states, or those characterized by unusual chemical pathology were already present before the institution of chemotherapy, it was necessary to employ measures directed toward these specific conditions. Particularly in the more protracted forms of the disease, admitted to study late in the clinical course, had these special measures been neglected, chemotherapy would undoubtedly have been much less effective.

Sulphaguanidine was not quite so effective in the recurrent attacks of bacillary dysentery and in the more chronic forms, as it was when used within 5 days of the onset of the original attack. If, however, the stools were bloody or contained pus, or if the culture demonstrated that they contained dysentery bacilli, the results were generally good. Even in those patients treated late, failures did not occur with absolute regularity. At times the beneficial effects of the drug were so striking, and so prompt even in the late stages, that one cannot escape the conviction that sulphaguanidine was so likely to yield a good result that, regardless of the stage of the disease, it should be administered in all cases of bacillary dysentery for at least 5 to 7 days in the manner recommended. With perhaps somewhat less evidence we were inclined to believe in the desirability of its use in practically all grave diarrhoeal states, the cause for which is not readily apparent, if they persist for more than 48 hours. If, at the end of that time, there is not a proper therapeutic response, the use of sulphathiazole or sulphadiazine for 5 to 7 days thereafter may be considered.

The impression just presented rests upon purely empirical observation. This much may be said, however, that much acute bacillary dysentery is unrecognized to-day, and it is generally in such a form that it is unrecognized. At times, most brilliant results occurred among patients of this group, patients who had an unrecognized dysentery bacillus infection.

Some of the most amazing results so far observed occurred in stubborn, serious cases of chronic bacillary dysentery. Generally we do not expect startling successes in these patients.

Relapse within the first 2 weeks after the use of sulphaguanidine in the treatment of acute bacillary dysentery were not common, occurring only 7 times in 267 patients. Certainly this was in striking contrast to the frequency with which they occurred in those not receiving chemotherapy.



Second infections, after 3 weeks or more of normal stools, occurred only 12 times in the same group. This is readily understandable when one considers the environmental situation to which the average one of these patients must return in his home, an environmental situation which provides unusual opportunity for repeated infections with the dysentery bacilli in a single individual.

There was no reason to believe, either from the bacteriological or from the epidemiological standpoint, that the use of sulphaguanidine tended to 'mask' infections of dysentery bacilli or to complicate the community health situation by increasing the 'carrier rate'. Our evidence along this line is admittedly incomplete.

In homes where outbreaks resembling the institution type of outbreak of bacillary dysentery have occurred, of which we had 5 clear cut, easily controlled ones, it was possible with sulphaguanidine to control promptly and effectively not only the individual cases, but the spread of the outbreak as well. The chemical has great value as a control agent in those crowded conditions of living which frequently are encountered in mining areas in the poorer districts and even in military camps or establishments. It would appear to be possible in an institution to check such an outbreak within a few days by giving everyone in the institution the chemical for a period of 5 to 7 days. It must be remembered in so doing that the maintenance dose should be employed, giving it only every 8 hours if the stools are less than 5 a day, as they are apt to be in those not already stricken with the malady.

Sulphaguanidine was of definite value in reducing the number of days of illness due to bacillary dysentery. Indeed this is one of the most striking influences which can be shown statistically. It is of unusual importance in industrial and military medicine. A wider use of the chemical will result not only in a continuously lower dysentery mortality rate, but in a greatly lessened economic loss from days of disabling sickness. Of the 259 patients treated with sulphaguanidine without regard to the time elapsing between the onset of illness and institution of chemotherapy, 219 patients had normal stools within 3 days, 21 in 4 days, 17 within 5 days, and only 2 had loose stools for more than 5 days. You will believe this with difficulty, I am certain.

Early recognition and early treatment are very important in the successful treatment of bacillary dysentery. This is more true in the actual clinical observations than the statistical evidence can reflect. The best results are definitely attained when chemotherapy is applied early in the disease. On the other hand, it may be effective, as we have seen repeatedly, when it is administered at a much later time.

Sulphaguanidine was as effective in the treatment of acute bacillary dysentery in adults as it was in infants and young children.

Chemotherapy has completely revolutionized the treatment of bacillary dysentery. Sulphaguanidine is quite as effective in the treatment of acute bacillary dysentery as sulphanilamide is in the treatment of some streptococcal infections or as the other sulphonamide compounds are in the pneumococcal infections. Besides its therapeutic effectiveness, the chemical is administered with ease, is well tolerated, and has such a wide margin of safety that it is the ideal agent for the treatment of bacillary dysentery.

### Bed-Bug Infestation

(Abstracted from *Medical Research Council, Special Report Series No. 245*)

1. PROVIDED a source of blood is available, temperature is the most important factor in the bed-bug's environment. At the end of winter, the bug population in an unheated room will consist mainly of adults and large nymphs; there will be few small nymphs and a large proportion of the adult females will be unfertile. It is unlikely that many bugs will feed until the

temperature rises to 16°C., in the middle of May. They may be supposed to feed, on the average, once a fortnight in the early summer, once a week in August, and then once a fortnight in September and October; after that feeding ceases, owing to the low temperature.

2. From the temperature and the number of feeds the production of eggs by a given bed-bug population may be calculated. The first egg will be laid in the latter part of May, and the production rises to a peak in August. The first adults of the next generation are not mature until the second week in August; the number attaining maturity reaches a peak early in October, and thereafter rapidly declines owing to falling temperature.

3. In November, when feeding and egg-laying have ceased in an unheated room, there will be large numbers of nymphs and adults, of generations  $F_1$  and  $F_2$  together. Nearly all the small nymphs, however, will die of starvation during the winter, and calculations indicate that the natural winter mortality in the bug population may be as high as 80 per cent. This emphasizes the practical desirability of concentrating on the destruction of bugs at the end of winter and in early spring, when the numbers are lowest; at that time of year there are no live eggs (which are more resistant to some fumigants than are nymphs and adults).

4. The conditions described above are modified in centrally-heated flats or in warmed living rooms. While even here a considerable winter mortality among eggs is probable, fasting bugs could survive very well and some feeding might occur throughout the year. It follows that the bug population in warmed rooms tends to increase enormously from year to year.

5. Besides the egg there are five nymphal stages of the bed-bug, the fifth and last moulting into the adult. An individual in each stage must take one full meal of blood before it can pass into the next stage. The rate of development depends both upon environmental temperature and upon accessibility of host.

6. Environmental temperature has an important influence upon the activity of bugs—the higher the temperature of a summer night, the greater the numbers active. Slight fluctuations of temperature have a marked effect on activity. The threshold of activity may be as low as 7° to 10°C.

7. A temperature of 13–14°C. is most favourable to long life of the bugs without food; both above and below this level life is materially shorter at comparable humidities; for long life humidity must be high, so as to prevent loss of water by evaporation. Adult virgin females and mated males live the longest. The period of survival of fasting adults may exceed one year under climatic conditions close to the optimum.

At 13°C. eggs develop and hatch, the mean period being 49 days; they develop very slowly at temperatures even as low as 4°C., but they are unlikely to hatch so long as the temperature remains always below 13°C. Survival of eggs through the winter in inheated houses is very improbable.

8. A temperature of 45°C. (113°F.) kills the eggs in one hour and nymphs in 15 minutes; adult bugs are killed by a temperature of 44°C. (111.2°F.) for one hour.

9. The physiological differences between populations of bugs maintained by feeding on different hosts—man, mouse and fowl—are small; the bed-bug is thus a non-specific parasite.

10. Sulphur dioxide has proved a poor ovicide, and not very toxic to the nymphal stages of the bed-bug. Its bleaching and corrosive properties render it unsuitable as a general fumigant.

11. A study has been made of the insecticidal powers of heavy naphtha and its constituents. An important outcome of the work has been the light thrown on the mode of action of contact insecticides and heavy fumigants; in nearly all liquid insecticides the toxic principle forms only a small part, either by weight or by volume. The greater part consists of a carrier with, it may be, the addition of substances ('wettors and spreaders') to ensure adequate spread or

adhesion of the insecticide on the body of the insect or on the surface on which the insect rests.

12. The practical use of hydrogen cyanide as a fumigant has been thoroughly investigated, and a detailed technique for its safe application has been worked out.

13. An account is given of the circumstances leading to the abandonment of orthodichlorobenzene as a fumigant against the bed-bug.

14. Heavy naphtha is a useful contact insecticide, but its vapour action is much more effective. Details are given of the technique of using heavy naphtha vapour to disinfest houses, and of experiments on its practical application for this purpose. The Committee's official specification for disinfestation naphtha is set out (p. 31). The effects of climate and temperature upon heavy naphtha fumigation are discussed, and an account is given of van fumigation for infested furniture.

15. Suggestions for further research on disinfestation, and a note on contact insecticides containing organic thiocyanates, are appended.

16. The value of domestic hygiene and cleanliness in the control of bed-bug infestation is emphasized. It is shown that bugs can often be eradicated from houses and furniture by simple though vigorous cleansing.

17. The cleansing of infested furniture and the structures of dwellings requires direction and supervision by competent officers, who must be well acquainted with the life history and habits of the bed-bug.

18. Infestation of new houses for slum clearance can be largely prevented by supervision of the cleansing of the household belongings in the old house immediately before the tenants are removed to the new. Prevention of infestation can be further ensured by a well-organized 'follow-up' system operated by health visitors.

19. The tenants themselves profit by instructions from these officers; educational efforts such as exhibitions of house pests are useful for instructing the public in domestic hygiene.

20. Details are given of the experimental methods used to investigate different contact and fumigant insecticides for their probable toxicities to man.

21. Of the insecticides investigated, orthodichlorobenzene is shown to be dangerous and heavy naphtha relatively safe. It is considered that provided the precautions outlined in section III of this Report are carefully observed, there should be little reason to expect any danger to man from the use of heavy naphtha as a fumigant. As an additional safeguard, however, it is recommended that toxicity tests on a wide range of animals should be carried out with each new sample of heavy naphtha before it is issued as an insecticide.

22. A note is included on the toxic effects of the higher thiocyanate contact insecticides—'Lethane 384' and lauryl thiocyanate—and on the precautions to be taken in handling these substances.

23. This section concerns building design in relation to bed-bug infestation. It is pointed out that new buildings should be constructed so as to give minimum harbourage for the bug, and so that, in the event of infestation occurring, eradication of the pest may be easily and cheaply effected. Detailed constructional suggestions are made from these points of view.

24. A note is given of the Committee's recommendations regarding the prevention of bed-bug infestation in public air-raid shelters (see also Appendix B).

### The Transmission of Kala-azar

(From the *Indian Journal of Medical Research*, Vol. XXX, 3rd July, 1942, p. 479)

THE recrudescence of kala-azar in severe epidemic form in Assam and certain adjoining areas, and also in Calcutta city, during the years from 1917 to 1929 afforded an opportunity for a fresh investigation on

the epidemiology of the disease. A phase of research was initiated in 1921 which has lasted up to the present time and during most of that period work has been especially directed towards the study of the sandfly as a possible vector of infection.

In 1921, an Inquiry on Kala-azar was started at the Calcutta School of Tropical Medicine by L. E. Napier with the active collaboration of R. Knowles. Certain epidemiological observations were made regarding kala-azar in Calcutta which led these workers to believe that a limited entomological survey of a certain part of Calcutta would be likely to indicate the insect responsible for transmission, and mainly for this purpose R. O. A. Smith joined this Inquiry in 1924. This Inquiry continued on a varying scale up to 1938 with L. E. Napier and later R. O. A. Smith in charge. *Phlebotomus argentipes* was found abundantly in this area and these workers selected this insect first for investigation for this reason and also because its general distribution in India coincided with that of kala-azar.

In 1924, a special Kala-azar Commission which absorbed the already existing Kala-azar Inquiry of the Indian Research Fund Association under H. E. Shortt was constituted to carry out field and laboratory investigations in Assam. S. R. Christophers was appointed Director, with H. E. Shortt as protozoologist and P. J. Barraud as entomologist. The Commission was financed on generous scale by the Indian Research Fund Association and was assisted by contributions from Local Governments concerned. In 1925, H. E. Shortt took over the Directorship and at varying periods A. C. Craighead, R. O. A. Smith, and K. V. Krishnan joined the Commission. C. S. Swaminath was a technical assistant during the period of investigation in Assam.

The first marked advance obtained was the finding of the development of typical herpetomonad forms in the fore-gut and mid-gut of the laboratory-bred *Phlebotomus argentipes* fed on parasite-containing blood of kala-azar patients, by the Inquiry in Calcutta. Later, this was confirmed by the workers in Assam.

A detailed account of the subsequent stages of the investigations on this species as a vector of kala-azar is embodied in the 1st and 2nd Reports of the Kala-azar Commission (*Indian Medical Research Memoirs*, Nos. 4 and 25) which cover the period up to 1931. Transmission to experimental animals by the bite of infected *Phlebotomus argentipes* had been obtained in a few instances but attempts to transmit in this way to human volunteers had not been successful. Many efforts had been made to obtain this final proof and the reasons for failure were obscure. The large-scale field work of the Commission was abandoned in 1931 and the matter was left in this disappointing position although much epidemiological and experimental evidence which had been obtained left little doubt that *Phlebotomus argentipes* was the vector.

On the closure of the Commission the Inquiry at the Calcutta School of Tropical Medicine was at first strengthened and later work was continued on a diminishing scale and was eventually reduced to a level which would only ensure such degree of continuity of experience as would provide a basis for renewed work in event of a fresh opportunity arising.

In 1939, kala-azar had assumed epidemic proportions in Bihar and R. O. A. Smith was placed in charge of a new inquiry in that province. The sandfly was again studied and new methods of breeding, maintaining and feeding *Phlebotomus argentipes* were developed, and with their use a much greater success than formerly was obtained in the transmission of kala-azar to experimental animals, all hamsters used being infected. Unfortunately, on account of war conditions, it was found necessary to close this Inquiry in 1941. Some of the technical staff was combined with those of a Protozoological Inquiry in the Madras Presidency which had also to be terminated and a combined team was formed which was posted to Assam to continue kala-azar work under direction. At this time kala-azar was recrudescing in that province and conditions existed in which it was possible to attempt again the transmission experiments to human volunteers under

suitable control. The new technique devised by Smith for obtaining sandflies in a highly infective state was employed. The successful result of this work has been recently reported by Swaminath, Shortt and Anderson.

Twenty years of patient investigation have gone to the forging of this final link in the evidence that *Phlebotomus argentipes* is the insect vector of human kala-azar in India, and the many workers who have taken part in the investigations at different stages and have contributed to the final solution of the problem are to be congratulated on this outcome of their work.

### Relative Nutritive Value of Different Forms of Milk

By S. K. KON

(Abstracted from the *Nature*, Vol. CXLVIII, 22nd November, 1941, p. 607)

THE present relative shortage of fresh liquid milk in Great Britain has made it important to assess the nutritional properties of other forms of milk. The author points out that the milk proteins and certain of the vitamins are most likely to be affected by various treatments. In raw milk the protein deficiency in building body protein may be as high as 90 per cent. The vitamin-A content reaches 150-200 international units per 100 ml. from May to December and drops to half that quantity for the rest of the year. The vitamin-D content is low, varying with the season and depending on the action of direct sunlight on the cow. The riboflavin content varies with the feed, rising from 100 microgrammes per 100 ml. in the stall feeding period to 150-200 microgrammes when the cows are of pasture. Vitamins-B<sub>1</sub> and C contents are independent of feed and vary little throughout the year, the vitamin-B<sub>1</sub> content being 10-15 international units per 100 ml., the vitamin-C content 2-2.5 mg. per 100 ml. The C content, however, falls off very rapidly on exposure to light. In the usual commercial preparations of milk, pasteurized, sterilized, spray or roller dried, and condensed sweetened or unsweetened, there is no loss of vitamin A or D, though in skim milk, fresh or dried, there is of course practically no A or D left. The only effect of pasteurization is to cause a 20 per cent loss of vitamin C and a 10 per cent decrease in vitamin-B<sub>1</sub> value. Sterilized milk shows a decrease of 6 per cent in the biological value of the proteins, a 50 per cent loss of C and a 30 per cent loss of B<sub>1</sub>. It has the advantage of keeping for a longer time than other liquid milks. Spray drying causes a loss of only 5 per cent in the biological value of milk proteins, a loss of 20 per cent of the vitamin-C content and 10 per cent of the B<sub>1</sub> content. Roller drying produces only a slightly inferior milk to spray drying. The proteins have deteriorated somewhat more, the loss of vitamin C is about 30 per cent and of B<sub>1</sub> up to 33 per cent. Sweetened condensed milk of good quality shows only a 5 per cent loss of C and a 5-10 per cent loss of B<sub>1</sub>. Unsweetened evaporated milk must be heated to a higher temperature to keep it. There is a slight decrease in protein value, a 60 per cent loss of C and a 30-50 per cent of B<sub>1</sub>. Skim milk except for the loss of A and D is nutritionally valuable because of its high protein, Ca and riboflavin content. The survey shows that all these various preparations of milk possess very valuable nutritional properties and can be used by the adult population as satisfactory substitutes of liquid milk.

British children, pregnant women and nursing mothers receive an extra allowance of fresh liquid milk.

### Interpretation of Chemotherapy Through Nutritional Studies

By H. McILWAIN

(Abstracted from the *Lancet*, Vol. I, 4th April, 1942, p. 412)

THE normal nutritional needs of bacteria can be found by chemical fractionation of their growth media,

and in many cases have been expressed in terms of pure substances. Nutritional analyses show that bacteria, in the presence of antibacterial agents (mercuric salts, acriflavine, sulphanilamide and other sulphonic acid derivatives), require more substances than are normally needed for their growth. The inhibitors (antibacterial agents) therefore increase the nutritional requirements of bacteria.

Some substances found necessary for normal bacterial growth (aneurin, cozymase) take part in enzyme reactions and these reactions account for the organism's need of such substances. The additional substances for which need is induced by inhibitors are probably required in order to take part in reactions which have been affected by the inhibitor.

Enzyme systems can in many cases be considered to correspond to the 'receptors' of Ehrlich. The structural specificity required for drug-action is comparable to that required in growth-essentials. Some grouping in a drug may be toxophoric by virtue of its similarity to a group in a growth essential; the SO<sub>2</sub>NH<sub>2</sub> of sulphanilamide simulates the -COOH of p-aminobenzoic acid to a degree sufficient for it to react with and block enzymes which are essential and normally react with p-aminobenzoic acid.

According to this view, chemotherapeutic interference is due to the functional replacement by the interfering agent of substances whose metabolism is affected by the inhibitor; acriflavine and some arsenicals interfere with (among other processes) hydrogen transport, which interfering agents, e.g., methylene-blue, are capable of performing.

Different organisms need different preformed substances for growth; enzyme processes involved in their growth are different and consequently a given inhibitor can affect various organisms differently. Such nutritional differences have been demonstrated between susceptible and non-susceptible species and strains of micro-organisms and may in part explain the difference in susceptibilities between host and parasite. Drug-fast strains are considered to have been 'trained' so that they differ in their nutritional needs or synthesizing abilities with respect to the essential metabolites with which the drug in question interferes. Amino-carboxylic acids are normally needed for growth of *Staph. aureus* and *Bact. typhosum* but organisms can be trained to synthesize them. Such trained strains are not susceptible to inhibition by alpha-amino-sulphonic acids, which inhibit normal strains by interference with their utilization of alpha-aminocarboxylic acids.

### Post-operative Administration of Fluids to Children

By G. M. ARNOTT

and

W. F. YOUNG

(Abstracted from the *Lancet*, Vol. I, 2nd May, 1942, p. 523)

DURING recent years much knowledge has been gained of the fluid requirements of adults in the post-operative period, and the present paper records an attempt to apply this knowledge to children.

Before a normal fluid balance can be maintained, the dehydration of an ill child must be relieved. Dehydration, varying from mild to moderate and severe, is relieved by volumes of fluid equivalent to 3 per cent to 6 per cent of the body-weight. Because metabolism, blood-volume and renal function are related to the surface area rather than to the body-weight, the normal daily fluid requirement of children was calculated by this formula:—

Child's requirement =

$$\text{Adult's requirement} + \frac{\text{surface area of adult}}{\text{surface area of child}}$$

The adult's requirement was taken to be 3,000 cm.<sup>3</sup>.

The authors have tabulated the requirements of children between the ages of 6 months and 14 years according to this calculation.

Easily remembered volumes are:—

|                                   |                                    |
|-----------------------------------|------------------------------------|
| 750 cm. <sup>3</sup> at 1 year    | 1,500 cm. <sup>3</sup> at 8 years  |
| 1,000 cm. <sup>3</sup> at 3 years | 2,500 cm. <sup>3</sup> at 12 years |

The indications for administering the fluid by the oral, rectal and intravenous routes are discussed. Ten per cent Dextri-maltose flavoured with fruit juice and a continuous drip of tea-water or 1/5 normal saline are recommended for use by the oral and rectal routes respectively. Normal saline (0.9 per cent) and 4.1 per cent glucose in 1/5 normal saline are used for intravenous therapy (this fluid is isotonic).

At the outset of treatment the normal daily requirement is supplemented by the extra volume necessary for the relief of dehydration. When using the intravenous route in a severely dehydrated child, this extra volume should be spread over the first 48 hours to avoid undue strain on an already embarrassed circulation. The use of normal saline is confined to the replacement, by approximate equal volumes, of fluid lost by vomiting, suction drainage or atherostomy. The administration of this solution in patients suffering from intestinal obstruction should be controlled by repeated readings of the blood chemistry. In all other circumstances 4.1 per cent glucose in 1/5 normal saline is used. Intravenous sodium sulphate and cane-sugar solutions are employed if a diuresis indicates.

The progress of the patient under this treatment is adequately controlled by frequent urinary examinations: a return towards a normal output, a fall in the specific gravity, the presence of chlorides and the absence of ketones being favourable signs. Serial analyses of the blood chemistry are invaluable in the more complicated cases. The author agrees with Jones and Morgan that a moderate acidemia is of no special significance in the absence of dehydration and is not in itself an indication for administering larger amounts of sodium chloride.

A fluid therapy which substitutes a water-retention and oedema for dehydration does not help the patient's recovery after operation. The aim of the present author's treatment, however, has been to restore a normal fluid intake and output. The application of the treatment is illustrated in six cases, showing the volumes administered and changes in the urine and blood chemistry. The renal improvement as the dehydration was relieved and the renal function returned to normal was most noticeable, and the recovery of a 7 months baby after a right hemicolectomy for gangrenous intussusception was particularly gratifying.

### The Pathogenesis of the Sprue-Syndrome

By HURST

(Abstracted from the *GHospital Report*, Vol. XCI, 19. 1)

HURST believes that the sprue, non-tropical sprue (or 'idiopathic steatorrhea' and coeliac disease (or 'Herter-Gee disease') varieties of the same disorder—the 'sprue syndrome'—which differ only in the part of the world in which they originate and in the age of the patient are three characteristic and constant features of the sprue syndrome:

- (1) the stools contain excess of split fat in the form of fatty acid crystals, but no excess of neutral fat, mucus or starch, and no inflammatory material
- (2) radiography detects the disappearance of the normal herring-bone pattern of the duodenal jejunal mucous membrane produced by the villi
- (3) no pathological changes are found in the intestines after post-mortem changes are prevented.

With adequate treatment the normal absorption of fat is restored together with the normal radiographic appearance of the duodenum and jejunum.

The author suggests the characteristic features of the sprue syndrome are the result of paralysis of

the muscularis mucosae. This would lead to loss of the pumping action of the villi, by means of which fat is conveyed from the lacteal radicles of the villi into the larger lacteals, and to flattening of the 'valvulae conniventes', the constantly changing pattern of which depends upon the activity of the muscularis mucosae, without any accompanying pathological changes in the mucous membrane. Paralysis of the muscularis mucosae may be secondary to loss of the normal stimulants of Meissner's plexus, from which it derives its nerve supply, or to the effect of vitamin deficiency or some toxæmia on the plexus.

An exception must be made for those cases of the sprue syndrome associated with disease of the mesenteric glands in which the hindrance to fat absorption occurs at the level of the glands instead of in the villi.

### A New Method of Controlling the Head Louse

By J. R. BUSVINE

and

P. A. BUXTON

(Abstracted from the *British Medical Journal*, Vol. I, 11th April, 1942, p. 464)

THE usual methods of treating for head lice are laborious and unpleasant. Also they give no protection from the rapid reinfestation which usually follows from relations or associates. The present authors, working from the Department of Entomology of the London School of Hygiene and Tropical Medicine, made tests on hundreds of infested young women and children, as a result of which they recommend the following insecticides as alternatives:—

(1) Twenty-five per cent technical lauryl thiocyanate (marketed in Great Britain and the U.S.A. as 'lorol rhodanate') in a white oil.

(2) Fifty per cent 'Lethane 384 Special' (12.5 per cent N-butyl carbitol thiocyanate; 37.5 per cent beta-thiocyanoethyl laurate; 50 per cent refined paraffin) in a similar oil.

(3) Derris emulsified to form a cream.

The advantages are:—

(a) That very little (2–8 cm.<sup>3</sup> according to the amount of hair) need be applied. This is rubbed about the scalp like an ordinary brilliantine or hair cream. It is not noticeable and therefore is not disliked by the patient.

(b) A single application will cure 90 per cent cases liable to reinfestation without combing out nits or any other measure.

(c) Hair clipped from a treated head up to a week after treatment is lethal to lice. This protects the patient from reinfestation during that time.

(d) The cost is low, being less than a half-penny per application.

Two disadvantages are:

(a) All three preparations have a slight disagreeable odour, but this can be easily masked by adding about 2 per cent citronella, etc.

(b) Frequent application of derris or thiocyanates to large areas of skin may cause dermatitis. But applied to the head as directed, most liquid is taken up by the hair. The authors found no symptoms at all in over 200 cases with each preparation.

### Sulphathiazole in the Treatment of War Wounds

By J. T. HEYL

(Abstracted from the *Proceedings of the Royal Society of Medicine*, Vol. XXXIV, October 1941, p. 782)

SULPHATHIAZOLE was used in 83 cases of injury, mostly associated with compound fracture; all but 8 of the wounds were over 24 hours old. The dose was 4 to 9 g. daily for 7 to 10 days; no increase of toxicity

occurred with the higher doses. The blood concentration was generally between 2 to 6 mg. per 100 cm.<sup>3</sup>; most often it was between 2 and 4 mg. Of the 83 cases, vomiting occurred in 7, skin rashes in 7 and fever in 7 (8.5 per cent), different cases being involved by the different affections. Four of the skin rashes resembled erythema nodosum; they appeared between the sixth and tenth days, the blood concentration being within the usual limits, and they disappeared within two days of stopping the drug. Similarly the drug-fevers were associated with average blood concentrations. No macroscopic haematuria due to sulphathiazole occurred; this freedom from urinary complications is attributed to the maintenance of a large fluid intake, over 100 ounces (about 2,800 cm.<sup>3</sup>), daily. The urine should also be kept alkaline. In some cases the concentration of drug in the urine rose as high as 450 mg. per 100 c.c., which is considerably above the saturation limit.

Thirty patients admitted for knee operations were given 10 gm. of sulphathiazole during the 18 hours before the operation. The blood levels ranged from 2.8 to 12 mg. per 100 cm.<sup>3</sup>, averaging 6.1 mg. The concentrations in the fluid of the knee joint were about the same, 80 to 86 per cent of the drug being present in the free form. In two cases in which the

joint fluids were septic the same result was obtained as in uninfected joints. This shows that sulphathiazole passes readily from the blood into joint cavities.

In some patients the compound was given prophylactically, to prevent infection developing. For this purpose a blood level of 2 mg. per 100 cm.<sup>3</sup> is desirable at the time of operation. The author's cases were not sufficient to assess the value of this procedure; but he notes that it did not prevent suppuration around pins in a significant percentage of cases.

In other patients the compound was given therapeutically, but the results are difficult to evaluate. The author gained the impression that sulphathiazole benefits wounds containing sensitive hæmolytic streptococci, but bacteriological proof could not be obtained.

When the compound is applied locally, according to the author's technique (not described), it persisted as lumpy masses; in vasine packs it often persisted for 2 to 3 weeks, and in bony recesses it has been observed after 6 weeks. In 6 patients, 1 to 4 gm. of the powder were spread round the wound in a thin layer; traces appeared in the blood after four hours and persisted for 14 days; the blood level never rose above 1.5 mg. per 100 cm.<sup>3</sup>. There was no constant effect, either deleterious or beneficial, upon epithelialization and the formation of granulation tissue.

## Reviews

**STITT'S DIAGNOSIS, PREVENTION AND TREATMENT OF TROPICAL DISEASES.**—By Richard P. Strong, M.D., Sc.D., D.S.M., C.B. Sixth Edition. Volumes I and II. 1942. H. K. Lewis and Company, Limited, London. Pp. xv plus 871 plus xi in volume I. Illustrated. And Pp. vii plus from 872 to 1747 plus xi in volume II. Illustrated. Price, £5-5-0 for two volumes combined

THE appearance of these two volumes on tropical medicine is an event of very great importance to all medical men in the tropics. Stitt's book on tropical diseases has enjoyed a world-wide reputation, probably second only to that of Manson's book, which was well deserved. It presents tropical medicine from the American point of view, which is not necessarily very different from that of the African and Asiatic points of view, but it is natural that there are here and there different emphases.

The present edition of Stitt's book is edited and largely re-written by Dr. R. P. Strong, Emeritus Professor of Tropical Medicine at the Harvard University. Dr. Strong has added as much as any living man to our knowledge of tropical medicine and it is very appropriate that he should assume the responsibility for this important book.

One cannot discuss the two volumes page by page though the reviewer would very much like to do so as he has spent some weeks perusing nearly every section most minutely. One can say that on the whole the information on every subject is both extensive and accurate. It is also presented in a very palatable form that will appeal to the student and research worker.

In nearly every subject, however, there is always some opportunity for difference of opinion and it is only natural that a writer will lay more emphasis on his own point of view. The malaria section is a very complete exposition of the subject and is entirely up-to-date; for example, he discusses in some detail the invasion of Brazil by *Anopheles gambiae*, imported from Africa. In the matter of treatment, Dr. Strong takes the older view regarding the value of large doses of quinine. This is not in concert with general world opinion on the subject, and it is a gospel that one would hesitate to preach at the present day, even if one's opinion did coincide with Dr. Strong's, in view of the very great quinine shortage.

The subject of blackwater fever is dealt with exhaustively and the modern point of view is well presented.

The section on trypanomiasis is good, particularly that of the South American trypanosomiasis. One feels perhaps that a little emphasis might be given to the question of goitre, and the inclusion of figure 52 showing a group of goitred children conveys the idea that this infection actually causes goitre, whereas recent work suggests that the association of *Trypanosoma cruzi* infection and goitre is an accidental one.

The section on leishmaniasis is equally good and perhaps the writer has done almost more than justice to the work that has been done on this subject in India and particularly at the School of Tropical Medicine, Calcutta.

A few diseases like typhus and undulant fever have been given much more space than are usually given to them in textbooks of this kind. This is not said in any critical spirit; on the contrary we feel that when a writer has paid special attention to any one subject he should give the reader the advantage of his special knowledge. This is particularly true in the case of undulant fever; probably nowhere else can such a comprehensive account of undulant fever be found as in this textbook.

Another similar example is Bartonellosis. The reviewer has acquired a much clearer mental picture of this unique disease from Dr. Strong's account than he ever had before, from his sources.

Cholera and the dysenteries are given very adequate treatment. To the epidemiology of cholera considerable space has been devoted and here as elsewhere good use is made of the epidemiological data collected by the Health Commission of the League of Nations. These chapters on cholera and dysenteries here is nearly a page devoted

The chapter on the rickettsias is an excellent one. It is interesting that typhus fever is not included in this chapter but is given a separate one. It seems doubtful to the reviewer that this disease deserves a separate chapter in a textbook of tropical medicine. It does not occur anywhere at the present day—and we are in the fourth year of a war—and it never was a tropical disease. When it could be fitted into the chapter on rickettsias there was some excuse for its



inclusion, but Dr. Strong won't give it place here, a decision which may or may not be a sound one.

The first real criticism applies to the section on leprosy. In this chapter there are certain points which are not usually presented in textbooks and which are very useful, but on the whole we feel that the chapter has been written from one point of view and is based on the experience of American workers, most of whom happen to have worked mainly in countries where leprosy is seen mainly or solely in its severest forms and where compulsory isolation is practised, so that the reader in India will find himself saying 'this picture may represent leprosy in some parts of the world but it does not describe leprosy as we see it here'. There are many mis-statements regarding leprosy in certain parts of the world and particularly in India; for example, the number of lepers in India is given as 100,000 which was an estimate made in 1893, and there are no references whatsoever to more recent estimates which often mention figures ten times this figure. There are many other examples where emphasis is given to old observations and to theories which have been superseded and abandoned. In the section on the pathology of this disease, there is no clear distinction made between the nodular and neural types which show very different histologies. Under clinical manifestations, the same criticism is applicable; no mention is made of the high incidence of very mild non-progressing cases of leprosy seen in some countries. Under nerve leprosy it is stated that wrist drop is not uncommon and that foot drop is rare, whereas actually the opposite is the truth. Under symptoms, it is stated that in the majority of cases of leprosy beyond the primary stage some rise of temperature is constantly observed. Experience of leprosy workers in general is that apart from the lepra reaction and a secondary infection, there is usually no rise of temperature whatsoever.

The account of the treatment of the disease is, on the whole, good but contains some inaccurate and misleading statements. It includes the remark that 'Engel Bey recommends . . .'. Engel Bey wrote 40 years ago and on the whole much too much emphasis is laid on older forms of treatment that have been superseded.

References are always a problem in a book of this kind. It is a problem to which there is no real solution and one sympathizes with the writers of certain standard textbooks who have solved it by giving no references at all. Dr. Strong's attempt at a solution is not very satisfactory. He has referred to innumerable workers in the text, but has only included a fraction of these amongst his references, and he has not been very careful to verify these. Perhaps the reviewer was unlucky, but the first six references he looked up were wrong in some important point.

To avoid closing this review on a querulous note, the reviewer will summarize his criticism by saying that the present edition has surpassed its predecessors in every way, in the amount of information, in the accuracy of its presentation, and in the general soundness of the views expressed, and that it has securely established the place of this book in the front rank of books on tropical medicine. As a book of reference on the whole subject of tropical medicine, it will be considered the best there is by the majority of workers in this field.

L. E. N.

**TEXTBOOK OF PATHOLOGY.**—By Sir Robert Muir, M.A., M.D., Sc.D., LL.D., F.R.S. Fifth Edition. 1941. Edward Arnold and Company. Pp. vii plus 991. Illustrated. Price, 35s.

Muir's book needs no introduction. It is one of the most reliable textbooks on the subject. Although first and foremost a Scottish student's book, it has been popular with medical students far and wide.

The present edition incorporates the chief advances which have been made in the various branches of pathology during the five years since the previous edition was published. A certain amount of re-modelling

has been made and some portions have been re-written, while a few descriptions have been condensed; this has afforded space for the new matter without increase in the length of the book.

The volume is divided into sections of general and special pathology, seven chapters (284 pages) being devoted to the former and thirteen (686 pages) to the latter. The sections on tumours, hæmopoietic system and endocrine glands are particularly good. The account of nephritis is full and up to date. In the treatment of less important diseases and some of the tropical conditions, the author seems to have exercised considerable restraint; this will not however affect an average student. The important additions to this edition include regional ileitis, vitamin K and its relation to coagulation, and to hæmorrhage in obstructive jaundice, Albers-Schönberg disease, the genetics of hæmophilia, etc.

Illustrations are numerous, well chosen and clearly reproduced. There are a number of references in footnotes to important monographs and special publications.

It is a remarkable achievement on the part of publishers to have been able to bring out such a well-printed volume with good paper in war time and give it to us at the pre-war price.

R. C.

**DISEASES OF THE RESPIRATORY TRACT.**—By Jacob Segal, M.D., F.A.C.P., F.A.C.C.P. 1941. Oxford University Press, London. Pp. ix plus 172. Price, 10s. 6d. Obtainable from Oxford University Press, Bombay and Calcutta

This synopsis or outline of diseases of the respiratory tract has little to commend it to the student for whom it appears to be intended.

It has the appearance of having been dictated from lecture notes to a non-medical secretary and of not having been revised as to spelling. Nor have the proofs been carefully read. There are, for instance, four spelling errors in the first fourteen pages—viz, 'Sica', 'particular', 'atack' and 'diagnoiss'.

Items for criticism occur upon thirty-one of its pages.

Although the symptoms and signs of lobar pneumonia are listed under ten headings no mention is made of the most important sign, bronchial breathing, or of other auscultation phenomena.

Pyrexia and tachycardia are not mentioned in massive collapse of the lung, though they occur early and characteristically.

The sulphonamides are mentioned but no dosage is given.

Fever, chills (1), vomiting and pain in the extremities are amongst the list of symptoms of acute follicular tonsillitis.

C. M. S.

**OBSTETRICS.**—By Harvey Clock Williamson, M.D., and George Schaefer, M.D. 1941. Oxford University Press, London. Pp. viii plus 113. Price, 10s. 6d. Obtainable from Oxford University Press, Bombay and Calcutta

This book is a synopsis of obstetrics and is not claimed by the authors to be a textbook on that subject. It is more essentially a synopsis than most books that bear that title, but every other page has been left blank, leaving ample space for more notes or sketches by the student. No unnecessary words are used and only important facts are included, but the subject-matter is well classified and should be of great help to the student in systematizing knowledge acquired by wider reading. The text includes recent advances in obstetrics such as the chemotherapeutic treatment and roentgenographical classifications of pelvic types by Caldwell and Maloy. This book should be of particular value to the student working for his qualifying examinations, and, though it will not teach him the art of obstetrics, it should be of considerable help in the final days of preparation for his examinations.



**HISTOLOGY AND EMBRYOLOGY.**—By Jos. F. Nonidez, Sc.D. 1941. Oxford University Press, London. Pp. ix plus 199. Price, 10s. 6d. Obtainable from Oxford University Press, Bombay and Calcutta

'The outline is not intended as a laboratory guide but merely as a supplement to a textbook.' This extract from the preface states fairly the nature of the book. A histology book without an illustration is no source of knowledge, but the average student may find it helpful in pre-examination revision. Perhaps brief comments on the relation between function and histological appearance might have been added without unduly increasing the size of the outlines.

The industrious student who will use the space provided for his own illustrations and additional notes, will find the histology section good. The embryology has suffered from excessive compression, so that in the absence of diagrams it can be understood only by the advanced student to whom the omission of many details will be irritating.

J. A. R.

**SURGERY OF HEAD AND NECK.**—By Arthur S. McQuillan, A.B., M.D., F.A.C.S. 1941. Oxford University Press, London. Pp. vi plus 138. Price, 10s. 6d. Obtainable from Oxford University Press, Bombay and Calcutta

IN 129 pages, the author has attempted an outline of surgery of head and neck which 'is meant to be an outline of general surgery'. This claim appears to rest solely on the inclusion of diseases such as rabies, glanders, and gas gangrene (but not tetanus). In the space available, he has been able to give little more than a catalogue of diseases and salient points rather disorderly in places and showing lack of balance, e.g. one-quarter of the book is devoted to the thyroid, and more space is allotted to malignant tumours of the thyroid than to head injuries.

This book might assist an unfortunate student faced with an examiner who demands a rapid numerical but superficial list of signs, complications, etc.

J. A. R.

**AIDS TO OSTEOLOGY.**—By Nils L. Eckhoff, M.S. (Lond.), F.R.C.S. Fourth Edition. 1942. Baillière, Tindall and Cox, London. Pp. vii plus 260 with 42 figures in the text. Price, 6s.

This little book, of pocket size, follows the orthodox treatment of its subject-matter. There is no undue compression; the whole is reliable and readable; and the information appears adequate for the ordinary student. Diagrams are introduced in this edition, and, while adequate for explanation, should not tempt the student from his real teacher—the bones. This can be recommended confidently to any student who is dismayed by the size of the ordinary textbook of anatomy.

J. A. R.

**FIRST AID IN EMERGENCIES.**—By Eldridge L. Eliason, A.B., M.D., Sc.D., F.A.C.S. Eleventh Edition. 1941. (With a Supplement on Civilian Defence and Poison Gases.) J. B. Lippincott Company, Philadelphia and London. Pp. xii plus 260 plus 16, with 126 illustrations. Price, 9s.

This book, first published in 1915, has now reached its eleventh edition. It is interesting to compare this American book with similar British publications, which tend to present their matter in a stereotyped manner often with the unnecessary use of medical and surgical terms or of special first-aid terms, and to devote too much space to unnecessary detail and to procedures which are of doubtful utility.

Why in first aid must we always call bleeding 'hæmorrhage', breathing 'respiration', a bruise 'contusion', the blood cells 'corpuscles'? Why cannot we call a fracture a break, and even the abdomen the belly? Why should we need use such terms as

'supine position', 'digital pressure', 'thermal disinfection', 'compound' and 'comminuted' fracture (surely 'open break' and 'smashed' or 'splintered break' are better terms), and 'upper' and 'lower extremities' (why not arm and leg)? Many persons taking first-aid training have never heard these terms and the whole subject tends to become unreal. Are these and other common faults avoided in American books on first aid? It appears that in this American publication to some extent they are, but not by any means entirely.

This book has a wider scope than most British publications and in many respects comes half way between the ordinary first-aid manual and the 'Home Doctor'. Because of the great distances in America, and the fact that medical aid to travellers, hunters, etc., may be delayed for days or weeks, the book describes some procedures usually left entirely to doctors.

The material and the presentation in the body of the book are good and the illustrations are numerous and excellent, but the unnecessary use of technical terms is not entirely avoided, and some of the bandaging and strapping procedures described and illustrated are perhaps unnecessarily complicated. It is, however, good to see a book on first aid in which general principles are usually stressed more than complicated detail. For example, in the treatment of 'fractured thigh (femur)' the principles are outlined and the need for traction is emphasized but there is not the usual detailed account of the precise number of bandages to be used and the site and the order of their application.

In addition to dealing with injuries, etc., the book has chapters on plant poisons (26 pages with many illustrations), medicines, emergencies, infectious and transmissible diseases, and abdominal pain.

The American background of the book is interestingly shown here and there. There is a note under gun-shot wounds which states that 'in civil life the bullet is usually soft lead'; there is a reference to tularæmia (which is wrongly stated to be 'a highly fatal condition') and also a mention of the 'kissing-bug'.

The Civilian Defence Supplement is far less satisfactory. It consists of sixteen pages, three and half of which are devoted to general behaviour in an air raid, one to bombs, particularly incendiary, and the remaining eleven and half pages to poison gases. There is no discussion whatever of the types of injuries commonly encountered in air raids and of their first-aid management and treatment. This supplement was obviously added hurriedly. It is of very little use to the first-aid worker.

The price of the book is rather high for a popular first-aid manual.

J. L.

**THE ADOLESCENT CRIMINAL—A MEDICO-SOCIOLOGICAL STUDY OF 4,000 MALE ADOLESCENTS.**—By W. Norwood East, M.D. (Lond.), F.R.C.P. (Lond.). 1942. Messrs. J. and A. Churchill, Limited, London. Pp. xi plus 327, with 112 tables. Price, 45s.

The author is a well-known authority on the psychology of crime, so that this book adds more lustre to his reputation. In this country where little, if any, attention is paid to the psychological aspects of crime and the mental make-up of offenders against the law, a book of this sort should not only be very welcome, but set an example to Indian psychiatrists to make a report along more or less the same lines as regards crime and criminals in India. The author states that the objects of his enquiry were four: Three were immediate in purpose: it was desired, first, to obtain the fullest information which would enable ample consideration to be given to each case before recommending the lad to the Court of Trial as a suitable subject, on general grounds, for detention in a Borstal institution; second, to ascertain the presence of any mental defectiveness or other mental abnormality which should be reported to the court; third, to utilize the medical data and other factors in the life

histories of the lads to assist in the classification of the various types of offenders and to ensure their transfer to the appropriate Borstal institutions. At the same time, this reduced the risk of contamination to a minimum and facilitated the application of different methods of training to the different types of offenders. At one end of the scale is a Borstal institution which receives the lads who have most experience in criminality, at the other end is an institution which receives lads in the initial stages of crime. In one institution the older lads are collected, in another those who require special attention on account of some physical disability or personality abnormality. The importance of detailed information in connection with the above will be seen from the fact that during the years 1930 to 1937, when the 4,000 lads were collected, some 21,512 lads received into Wormwood Scrubs prison were examined as to their fitness for Borstal detention. The fourth object of the investigation, with which we are here concerned, was as already stated, to apply modern scientific methods to the elucidation of some of the causal factors which contribute to adolescent criminality.

Each chapter begins with a discussion of the matter dealt with in the chapter and ends with a summary of the points recorded and discussed. Every feature—physical, psychological, sociological, environmental, et cetera—is dealt with in detail and illustrated with tables giving figures and percentages. It will be a surprise to many to learn that these observations show quite conclusively that the most 'criminal' age in a British boy's life is when he is 13 years old. The number of boys who are mentally, temperamentally, or normally abnormal at the age of 13 is nearly double the number aged 19. This fact disproves the assertion that crime is a 'disease'. Dr. East considers that juvenile crime is generally due to social immaturity rather than mental abnormality and that males commit crime more frequently than women, because their responsibilities are usually greater and their instinctive tendencies more despotic. Most people will agree with Dr. East that habits are more easily acquired than corrected, a matter noticeably true when an effort is made to rase habit-disorders, such as nail-biting, bed-wetting, constipation, stammering and some forms of habitual criminality. A habit, Dr. East maintains, is not broken by the passive acceptance of the admonition of someone in authority. Because of feeble motivation, bad habits are not overcome and for this reason many petty offenders become recidivists. One point that seems to have escaped the attention it deserves from Dr. East is the part played in the temperament of a child by his (or her) dread of losing the 'love' of others. Most students of child psychology seem agreed that loss of 'love' or a fear of its loss is an important factor in behaviourism and a potent cause of certain misdeeds, especially petty larceny.

It is satisfactory to have the assurance of so eminent an expert as Dr. East that public opinion in Great Britain is now opposed to methods of punishment which are essentially retributive, and favourable to those which are deterrent, preventive and reformatory. It is to be hoped that education and the inculcation of a keener sense of 'pity' will bring about a similar change in public opinion in this country.

O. B-H.

**NEW MEASURES FOR OBTAINING BETTER CONTROL AND PREVENTION OF VENEREAL DISEASES.**—By M. F. Lister, O.B.E., M.B., Ch.B. (Glasgow). E. and S. Livingstone, Edinburgh. Pp. 36. Price, 3d. postage 2½d.

AFTER seventeen years as a venereal disease specialist, the author's views on the subject have undergone radical changes, and in this booklet he pleads for the removal of the stigma of venereal from the two diseases, viz, syphilis and gonorrhoea, which, according to him, is not caused by sexual immorality only. He holds that mental unrest, strain and physical hardships contribute to the onset of these diseases, just as they

do in the case of tuberculous disease. He is not much in favour of the modern methods of control—indeed he considers them harmful, for they instil fear into the hearts of the people and fear is the fundamental cause of disease.

Dr. Lister believes that the initial lesion in syphilis arises from an infection within the body, not by coming in contact with *Spirochaeta pallida*, but by the spirochaetes and bacteria growing within the body and being carried by blood or lymphatics to the congested genital area or elsewhere. The fact that some sexual offenders escape infection is explained by their cleaner and healthier skin and mucous surfaces and better control of their emotions and actions. As regards gonorrhoea, it is really the *Micrococcus catarrhalis* that by passage through the body and growth in the genital area develops into gonococcus just as it develops into meningococcus, if it gains admission to the cerebrospinal fluid.

The booklet is written in a rambling fashion based on the author's sentiments and surmises and has, in our opinion, no scientific value. His 'new measures' for prevention consists in the cultivation of the love of a Divine Being, removal of poverty and causes of excessive anxiety and fear, etc.—on which, however, we have no dispute with him.

R. C.

(We would draw the paper controller's attention to this book.)

**HEALTH BULLETIN NO. 30. 'FOOD AND DIET.' WRITTEN FOR CHILDREN.** Published by The Manager of Publications, Delhi. 1942. Pp. 20. Illustrated. Price, Annas 3 or 4d.

THIS bulletin is meant to impart elementary knowledge about nutrition to children, as it is desirable that they should know that the kind of food they eat has a great influence on their health and that much ill-health and disease is due to eating the wrong sort of diet. It gives a concise account of the proximate principles of food; value of important articles of diet, cooking and regular meals, and some of the results of wrong feeding. Importance of milk as the best food for children has been stressed; India needs more milk and purer milk. There are a few illustrations—on sources of vitamins, milk consumption in different provinces, etc. The one on 'milking' of rice is obviously a misprint. It is strongly recommended that all schools should possess copies of this bulletin; and indeed it should prove valuable not only to children but also to many adults.

R. N. C.

## Abstracts from Reports

### ANNUAL REPORT OF THE SUDAN MEDICAL SERVICE FOR THE YEAR 1940

THE state of public health in the Sudan remained satisfactory during the year, with the exception of an extensive outbreak of yellow fever in the Nuba Mountains. Smallpox spread into Darfur and Kassala provinces from neighbouring countries, but it was possible to prevent an epidemic. Relapsing fever occurred as usual along the line of the pilgrim route across the Central Sudan. Cerebro-spinal meningitis occurred in the Southern Sudan. The low Nile flood and well spaced rains again resulted in a low incidence of malaria.

The hospital work in many parts of the country was disorganized temporarily owing to the Sudan becoming a theatre of war. Medical work as a whole had to be maintained on a care and maintenance basis, owing to the number of British and Sudanese medical staff of all cadres who were in the army. It says much for the remaining staff, who were often carrying on in the face of great difficulties, that the medical work as a whole was not more seriously

affected. It has been possible to maintain progress in preventive medicine, as this branch is so important in war that it must be maintained at a high standard of efficiency at all costs. The training of subordinate sanitary staff continued without interruption. The school medical and dental services were well maintained. Extensive research was carried out on kala-azar in the Eastern Sudan, and on yellow fever in the Nuba Mountains.

An extensive epidemic of yellow fever occurred in the Nuba Mountains. The disease broke out in July, and by the end of the year had practically died out. There were 15,633 cases, with 1,627 deaths. This disease had not previously been reported in the Sudan. Cases of smallpox were reported in Darfur and Kassala provinces, introduced into the Sudan from French Equatorial Africa and Arabia Saudia respectively. Relapsing fever occurred in the Central Sudan during the winter months and was particularly prevalent in the irrigated area of Gezira province. Cerebro-spinal meningitis was prevalent in the western part of Equatoria province.

Bilharziasis has ceased to be of any public health importance in the Northern Sudan, although stringent measures are necessary to maintain this state of affairs. The number of cases of kala-azar reported was higher than normal, probably due to the special attention given to the disease by the research staff of the Stack Laboratories and the increased popularity of hospital treatment as the result of the employment of new and more efficient drugs. The incidence of leprosy is probably slowly declining. Malaria was far less prevalent than usual in the Northern Sudan, owing to the exceptionally favourable climatic conditions. Cases of sleeping sickness continued to occur in the Zande district of Equatoria province, but no cases were reported from the Kajo Kaji district, where the disease occurred last year.

Three thousand two hundred and four pilgrims left the Sudan for Jedda, and were vaccinated and inoculated before departure with calf lymph and cholera vaccine made in the Stack Laboratories. Fourteen cases of smallpox occurred among the returning pilgrims who included many unvaccinated pilgrims who had left *via* Massawa. While the last boatload of pilgrims were in quarantine, the huts were bombed and machine-gunned by an Italian aircraft and four pilgrims were injured.

Fifteen medical students were under training at the Kitchener School of Medicine during the year, and training courses were held for public health officers, dispensers, sanitary overseers, female nurses, midwives, laboratory assistants, medical assistants, and hospital orderlies. Seven medical students passed the final examination of the Kitchener School of Medicine, and one public health student obtained the diploma of the Royal Sanitary Institute. Four medical officers completed a six months' post-graduate course in Khartoum in April.

In the Stack Medical Research Laboratories, twenty-five thousand six hundred and eighty-six routine examinations were carried out, compared with 24,540 in 1939, and 22,633 in 1938. The outbreak of war with Italy was followed by a temporary drop in the number of specimens received from civil hospitals, but there has been a considerable increase in the amount of work carried out for the army. One hundred and eighty-seven routine bacteriological examinations of water were carried out, and large quantities of vaccine made in the laboratories were issued during the year.

Investigations were carried out on kala-azar, typhoid fever, vaccine lymph and yellow fever.

The medical entomologists continued to carry out malarial research in the Gezira province. He also carried out entomological research in the Eastern Sudan on the sandfly distribution and habits as regards kala-azar, and in the Nuba Mountains on those of the *Aedes aegypti* and other possible vectors of yellow fever. The Wellcome Chemical Laboratories carried out analyses for departments and private firms, and 2,115 analyses were carried out during the year.

## ANNUAL REPORT OF THE NATIONAL ASSOCIATION FOR SUPPLYING MEDICAL AID BY WOMEN TO THE WOMEN OF INDIA (COUNTESS OF DUFFERIN'S FUND INCLUDING THE WOMEN'S MEDICAL SERVICE) FOR 1941

The work has continued steadily throughout the year in spite of war time conditions, and definite expansion in certain directions has taken place.

The Office of President of the National Association and its connected activities continued to be held by Her Excellency the Marchioness of Linlithgow, C.I., from whose extended stay in India we greatly benefit through Her Excellency's continued interest and advice. Sir Cameron Baderoch remained as chairman of the council and of the executive committee, and Lieutenant-General Sir Gordon Jolly, as vice-chairman. The only change in the executive committee was the replacement of the Hon'ble Sir Mohammed Yakub, Kt., by Sir Muhammad Yamin Khan, as one of the members nominated by Her Excellency the President, on the former's appointment to Hyderabad after five years of valuable service on the committee.

There have been eight meetings of the executive committee during the year and two meetings of the selection committee. The council meeting was held at the end of March at the Viceroy's House with Her Excellency the President in the chair, and this was followed by the annual general meeting.

At the end of 1940, the executive committee decided to suspend the post of medical adviser in the United Kingdom for the duration of hostilities, as all the members of the Women's Medical Service and Training Reserve had returned to India and it was unlikely that recruitment from overseas could continue for the present.

The greatest difficulty the hospitals have had to face this year has been the shortage of sisters and staff nurses owing to the demands of the army. When we consider that there are as yet only 5,000 registered, fully trained nurses in the whole of India, compared with 105,000 in Great Britain, and that many of these have been trained at small, poorly equipped hospitals and possess little in the way of educational qualifications, then we can only be thankful that our hospitals have been able to carry on with their limited staffs, and accomplish so much in the way of training pupil nurses and midwives as well as of caring for the patients, who continue to attend in increasing numbers in spite of the gradual breaking down of purdah customs.

Among the developments that have taken place during the year, the opening of two new hospitals and the building of a third are to be recorded. The fine Alice Horsman Memorial and Dufferin Hospital was opened at Cawmore by Lady Hallett, accompanied by His Excellency the Governor, on 26th March, 1941. This was erected at a cost of over three lacs of rupees through the princely generosity of Sir Henry Horsman and his brother, who were responsible not only for the building but also for the very up-to-date equipment. The hospital will have over 100 beds, including a considerable number in private rooms—an increase of 100 per cent on the previous accommodation.

At Quetta, the new Lady Sandeman Dufferin Hospital was able to function from early in the year, and it was not formally opened by Lady Metcalfe, the President, until 28th October. Conditions were very unsettled owing to the war and a recrudescence of earthquake shocks, and full use could not be made of the facilities provided; but it is expected that the volume of medical work will increase steadily as time goes on, and not only the women of the locality but also the children will benefit from this very comfortable little hospital.

At Jubbulpore plans for a two storied hospital of 80 beds were approved and the building was taken in hand at once, the foundation stone being laid by

Lady Twynnam on 1st . . . It is hoped th it will be completed by March 12 and then the wn will have good medical facilities for its women and children at last. The Countess of Dufferin's F . . . Council has contributed a sum of Rs. 17,000 . . . the building and equipment.

At Calcutta, the building or the Nurses' . . . of the Dufferin Hospital has commenced.

At Agra, a satisfactory exchange of buildings between the Medical College and the Lady Lyall Dufferin Hospital was agreed on.

This year the recurring income of the Countess of Dufferin's Fund was spent as usual on grants to provincial Dufferin branches and hospitals as well as on scholarships to students in Medical Colleges.

The work in the various hospitals officered by members of the Women's Medical Service has continued to progress in spite of a serious shortage of nursing staff, and difficulties caused by financial stringency and by lack of understanding of modern medical need by some of the municipal and other members of the hospital managing committees.

Members of the service have taken an active part in A. R. P. work when necessary, and others have volunteered to lecture in First Aid in their free time.

At the end of 1941 the strength of the service was 48; of these only 34 were confirmed and the rest were temporary members. Among these officers, seventeen were of European or colonial domicile, twenty-five were Indians, and the rest were members of the domiciled community of naturalized Armenians.

The main source of income of Countess of Dufferin's Fund is the interest it earns on investments which amounted to Rs. 774 (cost price) on 1st January, 1941. In addition, the Fund receives a fixed annual contribution of Rs. 40 from Their Excellencies the Viceroy and Vicereine and realizes rent of Rs. 2,250 from Irwin Lodge, Sirda, which was purchased in 1928.

#### ANNUAL REPORT FOR 1941 OF THE RESEARCH DEPARTMENTS OF THE COLLEGE OF THE PHARMACEUTICAL SOCIETY, LONDON

The college has now been temporarily accommodated in Cardiff. The work of the various research departments has continued. Further evidence has been obtained that the ordinary process of boiling vegetables does not decrease their vitamin A content. Two synthetic compounds have been obtained possessing physiological activity similar to that of corticosterone. Results of recent experiments indicate that the blood histamine increases after removal of adrenals. Injections of cortical extract given immediately after the operation apparently reduced the blood histamine within one hour, the effect lasting from 3 to 24 hours. The question of the immediate administration of cortical extract is briefly discussed, and an investigation to elucidate their problems is proceeding.

## Service Notes

#### APPOINTMENTS AND TRANSFERS

COLONEL J. B. HANCE, C.I.E., O.B.E., V.H.S., Officer on Special Duty in the Office of the Director-General, Indian Medical Service, is appointed to officiate as Deputy Director-General, Indian Medical Service, with effect from the 1st September, 1942, vice Lieutenant-Colonel (Ty. Colonel) R. Haj, C.I.E., granted leave.

Colonel R. Hy, C.I.E., assumed charge of the office of Inspector-General of Civil Hospitals, Punjab, with effect from the forenoon of the 1st October, 1942.

On his reversion from military duty Lieutenant-Colonel D. R. Thomas, O.B.E., was appointed as Chief Medical Officer, Air Raid Precautions, Punjab, with effect from the forenoon of the 19th October 1942.

On his reversion to military duty Major G. F. Taylor, Professor of Medicine, K. E. Medical College, Lahore, made over charge of his civil medical duties on the forenoon of the 1st October, 1942, to a non-I.M.S. Officer.

Major G. B. W. Fisher took over medical charge of the Dacca Central Jail from Dr. B. A. Ahmed in the forenoon of the 2nd September, 1942.

#### (Emergency Commissions)

##### To be Captains

V. D. Nimbkar. Dated 5th May, 1942.

S. N. Aggarwal. Dated 5th June, 1942.

T. R. R. Pai. Dated 3rd July, 1942.

##### To be Captains (on probation)

5th May, 1942

S. V. Velankar.

P. N. Bagchi.

##### To be Lieutenants

L. E. B. Gow. Dated 21st September, 1942.

Choithram Chandwani. Dated 27th September, 1942.

Minochahr Meherwanji Aderji Dubash. Dated 28th September, 1942.

#### INDIAN LAND FORCES

##### To be Lieutenants (on probation)

4th September, 1942

K. E. Robertson.

A. M. Mobsby.

K. N. Sen.

I. D. Singh.

R. I. Krishnaswami.

S. K. Sen.

C. S. Sandhu.

S. A. Narayanan.

Sheikh A. Rahim.

S. H. Massey.

M. M. Singh.

V. A. Damodaram.

B. V. Rao.

Kidiyoor.

5th September, 1942

G. Mandal.

M. Anantasayanam.

I. S. Saksena.

O. K. T. Keshavan.

I. M. Gupta.

A. C. K. K. Raja.

7th September, 1942

Gowrie Sanker Majumder.

Simara Puri Subramaniam.

Bandaru Seshagiri Row.

Mannargudi Raghavachary Jagannathan.

8th September, 1942

Sudhansu Mohan Ghosh.

Bandi Ramchandran.

Donnipad Ramanath.

9th September, 1942

Rangaswamy Natarajan.

Kandampully Sukumaran.

Eramilli Dikshitulu. Dated 21st September, 1942.

Echambadi Chakravarthy Srinivasan. Dated 28th September, 1942.

Banwari Lall. Dated 4th September, 1942.

6th September, 1942

Conjeeveram Sambanatha Balasubramaniam.

Muthuvelayatham Swaminathan.

Kuppuswamy Govinda Raj. Dated 7th September, 1942.

Abul Khair Muhammad Mujibur Rahman. Dated 14th September, 1942.

#### (WITHIN INDIAN LIMITS)

##### To be Lieutenants (on probation)

4th September, 1942

Constancio Apolinario Rodrigues.

Tarakad Appadurai Aiyar Ananthakrishnan.

Amar Chand Sood.

Walter Joseph Cyril Rebello.

Tirupattur Ramachandra Krishnamurthy.

Jugraj Sanghavi.

5th September, 1942

Sasanka Sekhor Hazra.

Subodh Chandra Roy.

Binati Kumar Gupta.

Debi Prosad Lahiry.

Sudhindra Nath Roy.

Collaparambil Eapen

Varkkey.

7th September, 1942

Vakkalanka China Kamaraju.  
Koyalmannam Narainier Raman.

(Relative rank)

To be Lieutenants (on probation)

(Mrs.) Ranji Kanta Puri. Dated 1st August, 1942.  
(Miss) Bhavani Natarajan. Dated 14th September, 1942.  
(Miss) Edith Jenley Smith. Dated 22nd September, 1942.

The undermentioned officer retires with gratuity and is granted an emergency commission from the date specified:—

## INDIAN LAND FORCES

(Short Service Commission)

Captain D. I. S. Bhalla. Dated 12th July, 1942.

To be Lieutenant (on probation) for service in the Indian Air Force

Ranajit Kumar Sen. Dated 27th August, 1942.

## LEAVE

Colonel P. B. Bharucha, O.B.E., D.S.O., V.H.S., Inspector-General of Civil Hospitals, Punjab, proceeded on leave, preparatory to retirement, with effect from the 1st October, 1942, to 20th February, 1943.

## PROMOTIONS

The undermentioned Indian Medical Service officer is advanced to the list of Special Selected Lieutenant-Colonels:—

Lieutenant-Colonel M. Das, M.C. Dated 10th June, 1942.

## INDIAN LAND FORCES

(Emergency Commissions)

Lieutenants (on probation) to be Captains (on probation)

K. R. Madhavan. Dated 6th April, 1942.  
T. K. Chary. Dated 5th May, 1942.  
H. C. Banik. Dated 5th June, 1942.  
D. S. Pathre. Dated 15th June, 1942.

3rd July, 1942

L. K. Chakraborty. S. Govindarajan.  
B. Guha.  
N. G. De Sarkar. Dated 10th July, 1942.

7th August, 1942

|                  |                    |
|------------------|--------------------|
| G. K. Roy.       | S. Mukherjee.      |
| D. C. Basak.     | D. P. Chakraborty. |
| B. K. Sen.       | B. N. Maji.        |
| S. C. Nath.      | J. M. Lewis.       |
| P. C. Mallik.    | J. M. Pinto.       |
| P. P. Ghosh.     | P. Banerjee.       |
| A. N. Basu.      | A. T. De Souza.    |
| Hamarayan Dubey. | Devaprasad Sen.    |
| B. Prasad.       | S. K. Sen.         |

B. R. Mahajan. Dated 8th August, 1942.  
K. G. Kapoor. Dated 23rd May, 1942.  
A. Gray. Dated 7th July, 1942.

29th July, 1942

I. L. H. Hewlett. M. E. M. Fleming.  
I. D. Patterson. M. E. M. Blanden.

(Relative rank)

Lieutenants (on probation) to be Captains (on probation)

(Miss) H. M. Herbert. Dated 6th April, 1942.  
(Miss) M. K. Beattie. Dated 1st July, 1942.  
(Mrs.) G. E. Brindley. Dated 12th July, 1942.  
(Miss) P. S. Davar. Dated 8th April, 1942.  
(Miss) D. M. J. Stracey. Dated 17th April, 1942.  
(Mrs.) S. L. Bhatia. Dated 2nd May, 1942.

(Miss) F. P. Wadia. Dated 4th May, 1942.  
(Miss) R. H. Fonseca. Dated 19th May, 1942.  
(Miss) M. W. Beeby. Dated 31st May, 1942.

1st June, 1942

(Mrs.) M. R. Tarapore. C. L. M. Drummond.  
(Miss) L. Bhargava. Dated 21st July, 1942.

5th August, 1942

(Mrs.) E. M. McDonald. (Miss) M. T. D'Silva.  
(Mrs.) E. H. Barrington. Dated 7th August, 1942.

8th August, 1942

(Miss) A. L. F. Hankins. (Miss) U. Roy.  
(Mrs.) C. K. Lal.

(Miss) J. B. V. Raj. Dated 14th August, 1942.  
(Miss) A. Matthew. Dated 24th September, 1942.

(Dental branch)

Lieutenant to be Captain

M. K. Sanjana. Dated 9th October, 1942.

## RETIREMENT

Lieutenant-Colonel V. R. Mirajkar, O.B.E. Dated 13th October, 1942.

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